CALFED BAY-DELTA PROGRAM
DELTA, SUISUN MARSH, AND EASTSIDE TRIBUTARIES
TECHNICAL TEAM MEETING REPORT

Prepared for

CALFED Bay-Delta Program
Ecosystem Roundtable

17 April 1997

CONTENTS

Page

1. INTRODUCTION 1

1.1 Technical Team Meeting 1
1.2 Meeting Overview 2
1.3 CALFED Planning Process Overview 2
1.4 General Session Presentations 2

2. STRESSOR CATEGORIES 3

3. STRESSORS 8

4. RESTORATION ACTIONS 9

APPENDIX A: Workshop Agenda and Attendee List
APPENDIX B: CALFED Planning Process, and Priority Species and Habitats
APPENDIX C: General Session Presentation on the Mokelumne River by Joe Miyamoto
APPENDIX D: Prospect Island Restoration Plan

D-026918

LIST OF TABLES

TABLE 1. STRESSOR CATEGORIES FOR THE DELTA AND SURROUNDING AREAS.

TABLE 2. DELTA STRESSORS AND PRIORITIES.

TABLE 3. SUISUN MARSH STRESSORS AND PRIORITIES.

TABLE 4. EASTSIDE TRIBUTARY STRESSORS AND PRIORITIES.

TABLE 5. STRESSORS AND POTENTIAL RESTORATION ACTIONS FOR THE DELTA.

TABLE 6. STRESSORS AND POTENTIAL RESTORATION ACTIONS FOR SUISUN MARSH.

TABLE 7. STRESSORS AND POTENTIAL RESTORATION ACTIONS FOR EASTSIDE TRIBUTARIES.

TABLE 8. STRESSORS AND POTENTIAL RESTORATION ACTIONS FOR ALL DELTA REGIONS (DELTA, SUISUN MARSH, AND EASTSIDE TRIBUTARIES).

1. INTRODUCTION

The CALFED Bay-Delta Program was established in May 1995 as a cooperative effort among seven state and federal agencies with management and regulatory responsibilities in the Bay-Delta. The program is aimed at developing a long-term solution to problems affecting the San Francisco Bay/Sacramento-San Joaquin Delta estuary in Northern California, with a focus on ecosystem quality, water quality, water supply, and system reliability. The Ecosystem Roundtable was formed as an advisory stakeholder group to CALFED to provide guidance regarding implementation of ecosystem restoration projects in the next three-to-five years.

CALFED is soliciting input from technical experts in a variety of disciplines and geographical areas to aid in identifying and prioritizing ecosystem problems and restoration actions. The Delta technical team was formed to provide input to CALFED on restoration actions in the Delta, Suisun Marsh, and eastside tributaries that would benefit priority species and habitats identified in the "Implementation Strategy to Identify Priorities for Bay-Delta Ecosystem Restoration." The technical team is one of five geographically defined teams that are providing input to CALFED for development of a workplan that will guide funding of near-term restoration actions.

1.1 Technical Team Meeting

On March 31 and April 1, 1997, the CALFED Bay-Delta Program held a technical team meeting at the Jean Harvie Center in Walnut Grove. The primary purpose of the meeting was to involve technical representatives from agencies and stakeholder groups in developing a package of priority fish and habitat restoration actions to be implemented in the near-term. These actions were focused on the legal Delta, Suisun Marsh, and eastside tributaries (Mokelumne River up to Camanche Reservoir, Cosumnes River up to Latrobe falls, and Calaveras River up to New Hogan Reservoir).

Based on the Implementation Strategy, the priority species for these areas included chinook salmon (particularly winter run, spring run, and San Joaquin fall run, although late-fall run may be included as well), steelhead, delta smelt, green sturgeon, and splittail. Species of secondary priority include striped bass and migratory birds. This list includes species that are listed or in decline, important commercial or recreational species that have declined, and species which are dependent on the Delta during some part of their life cycle.

Priority habitats for restoration actions in the Delta system include seasonal wetlands, tidal freshwater marsh, tidal saline marsh, shaded riverine aquatic (SRA) habitat, instream aquatic habitat, and in-channel Delta islands. These habitats have important relationships to the priority species.

1.2 Meeting Overview

A copy of the meeting agenda and attendee list is provided in Appendix A. The meeting began a review of ground rules, agenda changes (i.e., elimination of breakout groups), a general overview of the CALFED planning process, and selected background presentations on the Mokelumne River and the Prospect Island Restoration Plan. Following the presentations, the technical team participants identified stressor categories that were affecting priority habitats and species in each of the three Delta regions (Delta, Suisun Marsh, and eastside tributaries). Specific stressors were identified and ranked, the group identified potential restoration actions associated with these stressors. Unlike the specific stressors, potential restoration actions were not ranked.

1.3 CALFED Planning Process Overview

Cindy Darling gave a general presentation of the CALFED planning process, and cited four common components to all of the alternatives being considered by CALFED. These common components include water quality, water supply reliability, levee stability, and ecosystem restoration. Cindy explained that the technical teams are looking at actions that can begin to be implemented in advance of the Programmatic Environmental Impact Statements/Environmental Impact Report (PEIS/EIR). Cindy mentioned that two constraints that apply to near-term actions recommended by the technical team are that 1) the actions can not prejudge the long-term ecosystem restoration program, and 2) the Category III funding being utilized for many near-term activities is constrained to non-flow related actions.

Cindy presented several overhead slides on the funding cycle and process that CALFED is going through to implement near-term projects (Appendix B). She noted that the RFP process will begin in May for soliciting various types of restoration actions. Additional overhead slides were displayed regarding the habitat types that are the focus for near-term actions, and the geographical distribution of habitat types and species that are being considered (Appendix B). It was noted that late fall run chinook salmon in the Sacramento system and longfin smelt in the Delta may be added to the species list, but they have not yet been formally approved at all levels of the CALFED program. It was noted that the species that have been selected for the priority actions are, to some degree, surrogates for a wider suite of species and habitat components.

Cindy reviewed the technical team process and the desired results from the meeting, which are identification and prioritization of stressors for each technical team geographical area, and development of ideas regarding types of priority projects from a technical viewpoint.

1.4 General Session Presentations

A presentation was given by Joe Miyamoto from East Bay Municipal Utility District (EBMUD) on the Mokelumne River system. There are a number of fisheries management programs and restoration actions being taken on the Mokelumne River. In addition to EBMUD's work, there is a Technical Advisory Committee (TAC) working with EBMUD on management of the river.

The Mokelumne River is currently utilized by fall run chinook salmon and steelhead upstream of Woodbridge Dam, and by striped bass and American shad downstream of the dam. Salmon historically spawned in the Mokelumne River up to the upstream end of Camanche Reservoir. The Mokelumne River fish hatchery was built as a mitigation hatchery for the loss of salmon spawning habitat above the dam. Overhead slides from Joe's presentation are presented in Appendix C.

Katie Wadsworth of the Department of Water Resources (DWR) gave a presentation on the Prospect Island Restoration Plan being developed by the Army Corps of Engineers (ACOE), Bureau of Reclamation (USBR), and DWR. The Prospect Island project is to be part of the Stone Lakes Refuge. It involves breaching the current levee in a number of locations, and establishing islands, a flow-through channel, and approximately 1,300 to 1,500 acres of tidally influenced wetlands. The project includes development of Shaded Riverine Aquatic (SRA) habitat, and extensive fisheries and wildlife monitoring programs. Current challenges for the project include legal issues surrounding possible impacts on adjacent Ryer Island related to seepage and flooding issues, and contract issues between the various Federal and State agencies that are involved in the project. A copy of the preliminary restoration plan for Prospect Island is included as Appendix D.

2. STRESSOR CATEGORIES

Stressor categories were defined for each of the Delta regions (Table 1) using stressors identified within the Ecosystem Restoration Program Plan (ERPP), supplemented with stressors identified by participants at various times during the meeting. Each of these stressor categories are briefly discussed below (in alphabetical order).

Conversion of Tidal Marsh Area to Other Land Uses

Historical conversion of tidal marsh areas to diked seasonal wetlands and other land uses can be a stressor on aquatic species due to the loss of tidal shallow water, vegetated area that provides habitat for spawning, rearing, and food production. Land use changes and water development throughout the Delta have restricted the amount of tidal, shallow water habitat within the "mixing zone," and resulted in narrower, deeper channels that are less productive for several native species.

TABLE 1. STRESSOR CATEGORIES FOR THE DELTA AND SURROUNDING REGIONS.

Stressor Categories	Delta	Suisun Marsh	Eastside Tributaries
Conversion of tidal marsh area		✔	
Entrainment	✔	✔	✔
Exotic species (competition and predation)	✔	✔	✔
Flow constraints	✔		✔
Geomorphic factors			✔
Habitat fragmentation			✔
Harvest	✔	✔	✔
Hatcheries			✔
Human disturbance			✔
Lack of floodplain	✔		✔
Lack of foraging habitat	✔		
Lack of spawning habitat			✔
Migration barriers	✔		
Water quality	✔	✔	✔

Entrainment

Numerous diversions throughout the Delta, its eastside tributaries, and in Suisun Marsh present an entrainment or impingement risk to anadromous and other fish species. Entrainment of salmon fry and smolts, and other resident species, can be a significant source of direct mortality.

Exotic Species

Introduced exotic species are a stressor on native populations due to increased competition and predation. Introduced species such as striped bass and inland silversides are predators on delta smelt, and striped bass are documented predators on salmon smolts and fry. In addition, the introduced asian clam can become so abundant in some areas that the planktonic food supply for many native fish species could potentially be affected.

Flow Constraints

Inadequate or poorly timed flows can be a major stressor on the priority species in the Delta. Inadequate flow can lead to in changes in migratory behavior or migration delays, entrainment in the export pumps, inadequate food supplies, poor water quality, increased predation, and many other direct or indirect mortality factors. Poorly timed flows can have many of the same effects, since the native species of the Delta are largely adapted to wide fluctuations in flow that occur with the natural flow regime. Changes in the magnitude, duration, and timing of these fluctuations can adversely effect the population, even if the total volume of water between two different flow regimes is similar.

Geomorphic Factors

Alteration of the natural geomorphic processes in channels of the eastside tributaries can be a ecological stressor. Construction of upstream dams or diversions alters the sediment budget, and in some cases changes the frequency and magnitude of channel forming flows. Accelerated erosion processes due to land use changes result in increased fine sediment loads.

Spawning areas in the eastside tributaries can be adversely affected by increased fine sediment loads, decreased recruitment of appropriately sized spawning gravels, and other changes related to altered sediment budgets. Increased fine sediment loads result in decreased gravel permeability, which has a negative effect on dissolved oxygen concentration and metabolite removal rates in the redds. Spawning gravel quantities may can be limited, and existing gravels may be "cemented" into the streambed by accumulation of fine material in the interstitial spaces during low flow periods, thus reducing their suitability for redd construction.

Gravel mining is another stressor that is that occurs in the Mokelumne River. Adverse effects due to gravel mining include removal of spawning gravel and the associated changes in channel configuration, riparian vegetation, sediment budget, habitat conditions, and other factors.

Habitat Fragmentation

Habitat fragmentation is a stressor on the priority species because discontinuities in suitable habitat conditions can result in higher predation rates, inadequate food supply, loss of cover, adverse physical or chemical conditons (e.g., water velocities, depth, salinity, temperature, water quality, etc.), migration barriers, and other potential mortality factors. Since all of the priority species are migratory, fragmentation of habitat is a stressor during at least a portion of their life cycle.

Harvest

Harvest is a direct mortality factor that affects populations of salmonids, striped bass, and other species. The significance of legal harvest as stressor on maintenance or recovery of salmon

populations is an issue of considerable debate. For salmon runs that are already small (such as winter run), the potential for commercial harvest to be a major stressor is disproportionately greater than it would be for larger populations.

Illegal harvest is another direct mortality factor that can adversely affect salmon production. Poaching of migrating adult salmon after they have entered the tributaries can be particularly detrimental, since most of these fish would have successfully spawned and contributed to greater smolt production.

Hatcheries

Hatchery production of salmon smolts can have a beneficial effect on overall salmon production in the system, particularly if existing habitat is inadequately "seeded" or if drought conditions coupled with downstream impacts continue to cause dramatic declines in wild salmon populations. However, hatchery management practices may also have a deleterious effect on wild salmon fry, smolts, and spawners. Release of large numbers of smolts into the river could affect the migratory behavior of wild fry and smolts, and may affect food supply in localized areas. The genetic integrity of the wild salmon population can be adversely affected and result in decreased fitness, changes in run timing, loss of adaptability to changing environmental conditions, and lower reproductive success.

Hatchery production of striped bass introduces larger numbers of a predatory exotic species into the system, thereby increasing the direct mortality of other priority species that are a focus of restoration efforts. Artificial propagation of striped bass, as an important recreational species in the Delta that has been negatively affected by water diversions, raises complex issues related to balancing competing agendas for fishery management.

Human Disturbance

Human disturbance is a stressor related to land use and recreation in Delta regions. Examples of these stressors include trampling of redds in areas of high angler use, disturbance of fish and wildlife populations by jet skiers on the Mokelumne and Cosumnes rivers, recreational vehicle use above Highway 99 on the Cosumnes River, and boat wake erosion of SRA habitat in the Delta. The central location of the Delta regions and their proximity to major population centers in northern California results in human disturbance being a more significant stressor than in most other areas addressed by the CALFED program.

Lack of Floodplain

Floodplains are an essential component of a dynamic riverine and delta ecosystem that provide numerous benefits for fish and wildlife species. Floodplains provide important aquatic habitat during high flow periods, along with gravel and organic input to the riverine system that are critical to life stages of salmonids and other species. River meander processes that occur within

the floodplain of the eastside tributaries are critical to gravel recruitment and creation of habitat for a variety of fish and wildlife species. Inundation of vegetated areas in the Delta is critical for organic input to the system, and for spawning of native species such as splittail.

Floodplains are also an important area for development of SRA habitat, which provides terrestrial habitat to migratory birds and enhances aquatic habitat conditions for many special status aquatic species.

Lack of Foraging Habitat

Successful rearing and migration of fry or smolts requires adequate rearing habitat and food resources to maximize survival to either the ocean (anadromous species) or to other parts of the Delta. Resident fish species require year-round foraging areas in the Bay-Delta ecosystem. Poor food supply can decrease the fitness of priority species (particularly the younger life stages), subjecting them to higher predation rates, greater disease susceptibility, and other mortality factors. Shallow water habitat and inundated vegetation are necessary to provide adequate foraging areas and food production for many of these species.

Shaded riverine aquatic habitat is an important component of foraging habitat for both aquatic and terrestrial species. This type of habitat is has been significantly reduced due to flood control, water conveyance, and land use activities. Shaded riverine aquatic habitat provides important cover and food for juvenile salmon, spawning substrate for other fish such as Sacramento splittail, and refuge for juvenile fish during periods of high water. In addition, SRA habitat typically provides allochthonous material that supports nutrient cycling, and helps maintain the foodweb needed to support quality aquatic foraging conditions.

Lack of Spawning Habitat

Lack of spawning habitat is a stressor in all of the Delta regions, depending on the species of fish. Reductions in the quantity or quality of spawning areas in the eastside tributaries is a stressor on salmonid species caused by geomorphic changes, land use impacts, and flow constraints. Limited shallow water habitat and/or inundated vegetation in the Delta and Suisun Marsh can be a stressor on delta smelt and splittail, since these species typically spawn in such areas.

Migration Barriers

Restrictions on upstream or downstream movement of migrating fish species is a stressor because it may affect the physical condition (e.g., mechanical injury due to diversions, screens, dams, etc.), physiological condition (e.g., spawning readiness, smolting, etc.), and/or ecological status (e.g., predation risk, run timing, outmigrant survival, etc.) of anadromous fish. Upstream and downstream passage can be impaired by discontinuities or perturbations in the migration corridors such as diversions, reverse Delta flows, areas of poor water quality, and other factors.

Barriers to upstream movement may result in the elimination of many miles of salmonid spawning habitat in the eastside tributaries, and delays in upstream migration can increase predation risks and decrease spawning success. Downstream migration may be significantly affected by various diversion structures, and by flow changes in the Delta and Suisun Marsh.

Water Quality/Toxicity

Introduction of toxic compounds from agricultural or urban runoff, or from point sources such as industrial facilities, can have an acute or chronic toxicity effect on fish and wildlife in the Delta. This degradation of water quality may have negative cumulative effects on native fish production, particularly for younger life stages that may have longer exposure and higher sensitivity to toxic compounds. The success of a variety of restoration projects could be limited if underlying water quality problems are not identified and addressed.

Water Temperature

High water temperature is a specific water quality related stressor in the Delta regions that may affect salmonids and other priority species. The particularly significant influence of high water temperature during the egg, fry, and smolt lifestages of salmon and steelhead results in a cumulative mortality effect that could substantially reduce the number of outmigrants.

High water temperatures can be caused by reservoir operations, low flows due to water diversion, lack of shade, warmer water inflow from agricultural or municipal sources, or reduction of cooler groundwater inflow. Water temperature is a stressor in many Central Valley streams in some years due to natural flow and meteorological conditions, regardless of any human induced changes in the system.

3. STRESSORS

Following identification of the stressor categories and the Delta regions to which they applied, individual stressors for each region were identified. For each specific stressor within a category, affected habitat types (seasonal wetlands, shaded riverine aquatic, instream, etc.) within the Delta region were identified (Tables 2 - 4). If a particular stressor was identified as affecting a habitat type, it was assumed to affect some or all of the species dependent upon that habitat type. In some cases stressors were identified which directly affected particular species, without a pronounced effect on the habitat (e.g., entrainment, predation, etc.). In these cases, the species affected by the stressor were individually identified in Tables 2 - 4.

Table 2. Delta Stressors and Priorities

STRESSORS	Priority [1]	Affected Habitats: Tidal Freshwater Marsh	Seasonal Wetlands	SRA	Saline Tidal Marsh	In-Channel Islands	Species Impacts Included with Affected Habitats	Affected Species: S.J. Fall Run Chinook	Winter Run Chinook	Spring Run Chinook	Steelhead	Delta Smelt	Green Sturgeon	Striped Bass	Splittail	Migratory Birds
ENTRAINMENT	89							✓	✓	✓	✓	✓	✓	✓	✓	
EXOTIC SPECIES																
Exotic Species	64	✓	✓	✓	✓	✓	●									
Predation and Competition	34							✓	✓	✓	✓	✓	✓	✓	✓	✓
FLOW CONSTRAINTS	100	✓	✓	✓	✓	✓	●									
HABITAT FRAGMENTATION	40	✓	✓	✓	✓	✓	●									
LACK OF FLOODPLAIN																
Bank Protection	30	✓	✓	✓	✓	✓	●									
Land Use Intensification	28	✓	✓	✓		✓	●									
Lack of Floodplain (channelization)	83	✓	✓	✓	✓	✓	●									
Land Use Conversion (historic)	15	✓	✓	✓	✓	✓	●									
LACK OF FORAGING HABITAT	55							✓	✓	✓	✓	✓	✓	✓	✓	✓
MIGRATION BARRIERS																
Migration Delays and Impediments	53							✓	✓	✓	✓	✓	✓	✓	✓	
WATER QUALITY																
Contaminants	34	✓	✓	✓	✓	✓	●									
Water Quality	70															
Salinity		✓	✓	✓	✓	✓	●									
Point Source		✓	✓	✓	✓	✓	●									
Non-point Source		✓	✓	✓	✓	✓	●									
Water Temperature	13	✓	?[2]	?[2]	?[2]	?[2]	●									

Table 2. Delta Stressors and Priorities

STRESSORS	Priority [1]	Affected Habitats: Tidal Freshwater Marsh	Seasonal Wetlands	SRA	Saline Tidal Marsh	In-Channel Islands	Species Impacts Included with Affected Habitats	Affected Species: S.J. Fall Run Chinook	Winter Run Chinook	Spring Run Chinook	Steelhead	Delta Smelt	Green Sturgeon	Striped Bass	Splittail	Migratory Birds
GEOMORPHIC FACTORS																
Lack of Sediment	21	✓	✓	✓	✓	✓	●									
HARVEST																
Fish and Wildlife Harvest Legal (overharvest)	6							✓	✓	✓	✓		✓	✓	✓	
Fish and Wildlife Harvest Illegal	0							✓	✓	✓	✓		✓	✓	✓	
HUMAN DISTURBANCE																
Boat Wakes	17	✓		✓	✓	✓	●									
LACK OF SPAWNING HABITAT	34											✓		✓	✓	
OTHER STRESSORS																
Dredging (historic)	0	✓			✓	✓	●									
Climate Change	13	✓	✓	✓	✓	✓	●									
HATCHERIES	19															
Salmonid								✓	✓	✓	✓	✓				
Striped Bass								✓	✓	✓	✓	✓		✓		

[1] Priorities are based on a normalized (0-100) distribution of the number of votes the stressor received.

[2] Question marks indicate areas of disagreement among technical team meeting participants.

D—026929

Table 3. Suisun Marsh Stressors and Priorities

STRESSORS	Priority [1]	Affected Habitats		Affected Species										
		Tidal Marsh	Diked Seasonal Wetlands	Species Impacts Included with Affected Habitats	S.J. Fall Run Chinook	Winter Run Chinook	Spring Run Chinook	Steelhead	Delta Smelt	Green Sturgeon	Striped Bass	Splittail	Migratory Birds
ENTRAINMENT (in diked wetlands)	76				✓	✓	✓	✓	✓	✓	✓	✓	
EXOTIC SPECIES													
Exotic Species	76	✓	✓	●									
Predation and Competition (striped bass vs. indigenous fish species)	0				✓	✓	✓	✓	✓	✓	✓	✓	
FLOW CONSTRAINTS													
Low Flow	35	✓	✓	●									
HABITAT FRAGMENTATION	53	✓	✓	●									
LACK OF FLOODPLAIN													
Lack of Floodplain (along CCCo. Shoreline due to urbanization/industrial)	6	✓		●									
Conversion from Tidal to Managed Wetlands (historical)	100	✓		●									
Bank Protection	18		✓	●									
LACK OF FORAGING HABITAT													
Lack of Food Supply	18				✓	✓	✓	✓	✓	✓	✓	✓	✓
MIGRATION BARRIERS													
Migration Delays and Impediments (for birds - lack of flooding; for fish - salinity control barrier)	6				✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 3. Suisun Marsh Stressors and Priorities

STRESSORS	Priority [1]	Affected Habitats: Tidal Marsh	Affected Habitats: Diked Seasonal Wetlands	Species Impacts Included with Affected Habitats	Affected Species: S.J. Fall Run Chinook	Affected Species: Winter Run Chinook	Affected Species: Spring Run Chinook	Affected Species: Steelhead	Affected Species: Delta Smelt	Affected Species: Green Sturgeon	Affected Species: Striped Bass	Affected Species: Splittail	Affected Species: Migratory Birds
WATER QUALITY													
Water Temperature (circulation/water impoundments within Suisun Marsh; dead-end sloughs)	6	✓	✓	●									
Contaminants (refineries)	47	✓	✓	●									
Non-point Siltation from Managed Wetlands	12	✓	✓	●									
Water Quality (salinity, DO)	59	✓	✓	●									
GEOMORPHIC FACTORS													
Subsidence	0		✓	●									
HARVEST													
Fish and Wildlife Harvest	0				✓	✓	✓	✓		✓	✓		
HUMAN DISTURBANCE													
Boat Wakes	6	✓	✓	●									
OTHER STRESSORS													
Dredging (lack of)	0		✓	●									

[1] Priorities are based on a normalized (0-100) distribution of the number of votes the stressor received.

Table 4. East Side Tributary Stressors and Priorities

STRESSORS	Priority [1]	Affected Habitats			Affected Species									
		Seasonal Wetlands	SRA	Instream Habitat	Species Impacts Included with Affected Habitats	S.J. Fall Run Chinook	Winter Run Chinook	Spring Run Chinook	Steelhead	Delta Smelt	Green Sturgeon	Striped Bass	Splittail	Migratory Birds
ENTRAINMENT	53													
Mokelumne						✓			✓					
Cosumnes						✓								
Calaveras						✓								
EXOTIC SPECIES														
Birds and Fish	3					✓								✓
Plants	10													
Hydrilla				✓	●									
Arundo (Giant bamboo)		✓	✓		●									
Tamarisk			✓	✓	●									
Predation and Competition (due to striped bass)	10					✓								
FLOW CONSTRAINTS														
Inadequate Stream Flows	100													
Due to diversions (Cosumnes)		✓	✓	✓	●									
Check dams (Calaveras)		✓	✓	✓	●									
Mokelumne		?[2]	?[2]	✓	●									
HABITAT FRAGMENTATION	87	✓	✓	✓	●									

Table 4. East Side Tributary Stressors and Priorities

STRESSORS	Priority [1]	Affected Habitats: Seasonal Wetlands	SRA	Instream Habitat	Species Impacts Included with Affected Habitats	Affected Species: S.J. Fall Run Chinook	Winter Run Chinook	Spring Run Chinook	Steelhead	Delta Smelt	Green Sturgeon	Striped Bass	Splittail	Migratory Birds
LACK OF FLOODPLAIN														
Bank Protection	0	✓	✓	✓	●									
Land Use	23													
Grazing		✓	✓	✓	●									
Conversion into vineyards, golf courses		✓	✓		●									
Pierces disease control on riparian			✓		●									
Lack of Floodplain	73													
Cosumnes channel entrenchment		✓	✓	✓	●									
Historically dredged areas (gold)		✓			●									
Encroachment		✓	✓	✓	●									
LACK OF SPAWNING HABITAT	50					✓			✓					
MIGRATION BARRIERS														
Migration Delays (impediments)	10					✓			✓					
Impoundments (check dams)	7			✓										
WATER QUALITY	10	✓	✓	✓	●									
Contaminants	10													
Cosumnes: same issues as Delta				✓	●									
Mokelumne: Orchard spray causing mid-channel fish kills		✓	✓	✓	●									
Mokelumne: Grazing		✓			●									
Water Temperature	37													
Flow related (Cosumnes)				✓	●									
At Woodbridge Dam (Mokelumne)		?[2]	?[2]	?[2]	●									

Table 4. East Side Tributary Stressors and Priorities

STRESSORS	Priority [1]	Affected Habitats: Seasonal Wetlands	Affected Habitats: SRA	Affected Habitats: Instream Habitat	Affected Species: Species Impacts Included with Affected Habitats	Affected Species: S.J. Fall Run Chinook	Affected Species: Winter Run Chinook	Affected Species: Spring Run Chinook	Affected Species: Steelhead	Affected Species: Delta Smelt	Affected Species: Green Sturgeon	Affected Species: Striped Bass	Affected Species: Splittail	Affected Species: Migratory Birds
GEOMORPHIC FACTORS														
Lack of Channel Complexity	17	✓	✓	✓	●									
Sedimentation	7													
Coarse sediments (Mokelumne)				✓	●									
Coarse sediments (Calaveras)				✓	●									
Gravel Mining	3													
Active (Mokelumne)				✓	●									
Historic (Mokelumne)		✓	✓	✓	●									
Dredging	0	✓	✓		●									
OTHER STESSORS														
Human Disturbance	10													
Disturbance of redds by anglers (Mokelumne)				✓	●									
Fences/barriers for pumping (Mokelumne)				✓	●									
RV use above Hwy 99 (water quality) (Cosumnes)		✓		✓	●									
Jet skis (Mokelumne and Cosumnes)				✓	●									
Fish and Wildlife Harvest (ocean and instream)	17													
Legal						✓			✓					
Illegal (Mokelumne)						✓								
Hatcheries	10					✓	✓	✓	✓					

[1] Priorities are based on a normalized (0-100) distribution of the number of votes the stressor received.
[2] Question marks indicate areas of disagreement among technical team meeting participants.

Stressors were prioritized by having the meeting participants vote (using multiple votes per participant) on each stressor. Criteria considered in the voting for each stressor included the following.

- Effects on multiple habitat types and species
- Significance of the effect on the habitat and species
- Whether potential restoration actions addressing the stressor were technically based (as opposed to politically or financially driven) and would produce measurable results.

This process was repeated independently for each of the Delta regions. The number of votes received for each stressor in each different region was normalized on a scale from 1-100.

Discussion of the various stressor categories included a concern that a representatives from the hatcheries should be involved in the technical team, since hatcheries were identified as a potential stressor on several priority species in the Delta (due to striped bass predation, and genetic or other effects on salmon populations). A concern was expressed related to Suisun Marsh operations, since changes in the timing of controlled flooding could potentially delay waterfowl migration. Flood timing can also affect fish habitat, since it alters the availability of aquatic habitat and the location of potential salinity barriers.

Discussion of stressors on the eastside tributaries noted that the dredging activity refers to suction dredgers used by gold miners. Instream habitat fragmentation on the tributaries refers to areas of discontinuous flow (particularly on the Cosumnes and Calaveras rivers). Golf courses in the floodplain of eastside tributaries were noted as a contaminent and land use issue. Potential effects of hatcheries on winter run salmon were noted, but more localized effects such as migration delays were not considered because winter run are not currently in the system. It was suggested that winter run in the eastside tributaries should be considered under CALFED's longer term program.

There was considerable discussion of flow and water temperature related issues on the Mokelumne River. There was no concensus among the technical experts regarding whether these are currently stressors in the system, given recent agreements being negotiated between EBMUD and the fisheries agencies.

4. RESTORATION ACTIONS

Restoration actions were identified under the various stressor categories for each of the Delta regions by soliciting ideas from the meeting participants. Restoration actions were generally identified for the highest priority stressors in each region, since these types of actions were of greatest interest for near-term implementation. The itemized list of actions is presented in Tables 5 - 7 for each region. Table 8 includes actions for water quality and exotic species concerns that apply across all regions.

Additional discussion of the restoration actions included the paradox of striped bass culture as a stressor (exotic species) and a mitigation measure. There are divergent views on this issue among the CALFED agencies, and there is continued discussion and information exchange on this matter.

Comments on other stressors included the need to address the lack of foraging habitat for both fish and migratory birds, rather than just fish. During discussion of Suisun Marsh actions it was noted that subsidence implications need to be a criteria when evaluating conversion of habitat types between tidal areas and managed seasonal wetlands.

Dredging activity related to bank protection in the Delta is an issue about which there is disagreement among the technical team participants. A concern was expressed that a cumbersome regulatory process has precluded maintenance dredging and caused most dredging activity to be done as an "emergency action" with little oversight. Others felt that this was not the case.

D-026936

TABLE 5. STRESSORS AND POTENTIAL RESTORATION ACTIONS FOR THE DELTA.

Stressor Category	**Potential Restoration Action**
Entrainment	Screen diversions. Consider a prioritization method that evaluates largest to smallest diversions, mainstem versus side channel locations, and possible high priority areas.
	Land retirement to decrease the need for water diversion.
	Establish a cooperative effort to study and implement screening of diversions, including consolidation of diversions where appropriate and screen maintenance. Also need to maximize the cooperative aspects of the program.
	Change operations and physical facilities at the State and Federal pumps to reduce entrainment.
	Evaluate possible changes and operations of other diversion facilities to reduce entrainment.
Exotic Species	Implement a program to prevent introduction of exotic species into areas that are currently supporting native species.
	Provide additional zebra mussel control (refer to the California Task Force for zebra mussel control).
	Fund studies to better understand the biology of exotic species in order to support control or eradication efforts.
	Fund additional study of the effects of striped bass on salmonid species.
	Form a group of cooperating entities into an exotic species "SWAT" team.
	Study the effects of inland silverside predation on delta smelt.
	Establish education programs regarding existing exotic species problems and the need to prevent deter future exotic species introductions.
	Provide additional resources to increase the enforcement of ballast discharge regulations in areas where introduction of exotic species is a risk.
	Establish a trapping program for brown headed cowbirds and starlings which compete with native species in riparian areas.
	Implement projects to reclaim priority habitats from exotic plant species.

Stressor Category	Potential Restoration Action
Flow constraints	Water conservation actions.
	Manipulation of flow timing.
	Water acquisition.
	Study options for operations for the Old River barrier.
	Study flows in the Yolo Bypass and San Joaquin River for potential splittail spawning.
	Study the effectiveness of pulse flows in the San Joaquin system and their relation to potential improvements in survival.
Lack of floodplain (channelization actions)	Establish setback levees to create shallow water habitat and other priority habitat types. Consider possible adverse trade-offs between habitat types that may be created with setback levees.
	Create a flood bypass in the southern Delta and on the lower Mokelumne River. Refer to the work of the Levee Technical Committee on this action.
	Consider land use changes and restoration in the Yolo Bypass.
	Modify drainage in the Yolo Bypass to reduce fish stranding.
	Prioritize areas for use of dredge material or other mechanisms on subsided islands (refer to the work of the Levee Technical Committee).
	Work with landowners to establish easements for seasonal wetland habitat creation and other priority habitat.
Lack of foraging habitat	Increase area of flooded agricultural lands. Combine with no net loss of agricultural wetlands that provide foraging habitat for migratory birds.
	Fund incentives to increase area of agricultural wetlands and foraging habitat for migratory birds.
	Fund projects to restore tidal mudflats in shallow water habitat.
	Fund programs to prevent the loss of tidal mudflats and shallow water habitat.
	Create aquatic habitat that will be useful for fish rearing and migratory bird foraging.

Stressor Category	Potential Restoration Action
Migration Barriers	Operate the Delta Cross Channel gates to prevent migration delays of fish. Also consider Georgiana Slough modifications.
	Fund land retirement adjacent to temporary barriers.
	Evaluate pulse flow effects on fish migration.
	Provide dissolved oxygen, migration barrier relief through modifications at the fall barrier at the head of Old River.
Water Quality	Establish a Delta "streamkeeper".
	Research and develop TMDL's for all non-point and point sources of pollution.
	Fund land retirement, focusing on high salinity load areas.
	Locate and inventory storm drains emptying into the Delta.
	Promote educational efforts to prevent inappropriate use of storm drains.
	Develop and fund a storm water monitoring program.
	Develop and fund water quality monitoring programs in coordination with existing USGS or other agency upstream and downstream monitoring.

TABLE 6. STRESSORS AND POTENTIAL RESTORATION ACTIONS FOR SUISUN MARSH.

Stressor Category	**Potential Restoration Action**
Conversion of Tidal Marsh Area to Managed Seasonal Wetlands	Fund a cooperative effort with landowners to restore areas adjacent to the Suisun Bay entrapment zone to tidal action. This action would address subsidence issues.
	Analyze potential changes in the maintenance of Suisun Marsh to provide habitat for fish species. This would be a cooperative pilot project with a monitoring component. The project would also address land subsidence issues.
Entrainment	Accelerate and continue funding for screening.
	Study the biological significance of effects of any fish entrainment into Suisun Marsh.
	Establish annuity/endowment for operation, maintenance, and improvement for existing fish screens.
Exotic Species	Establish exotic species control programs in tidal and seasonal wetlands.
	Prioritize and implement programs for Asian clams, Chinese mitten crabs, and all other exotic aquatic species.
	Establish control program for inland silversides and yellow perch (see similar Delta actions).
	Establish public education program regarding exotic species (see similar Delta actions).
	Fund exotic species "SWAT" teams who can target individual species for control efforts over a broad geographical area.
	See other Delta exotic species actions.
Water Quality	Negotiate cooperative agreement with refineries to reduce selenium.

TABLE 7. STRESSORS AND POTENTIAL RESTORATION ACTIONS FOR EASTSIDE TRIBUTARIES.

Stressor Category	Potential Restoration Action
Lack of floodplain	Study and implement expansion of setback levees on the Cosumnes River, Mokelumne River (in the vicinity of Highway 99 to the Delta), and Calaveras River.
	Restore and add SRA habitat.
	Study the feasibility of reconnecting the incised channel to the floodplain on the Cosumnes River.
	Modify levee maintenance practices to enhance habitat.
	Assess and consider streamlined regulatory process and permit coordination on dredging to facilitate maintenance dredging.
Lack of spawning habitat	Re-establish meander zone on the Cosumnes River.
	Restore and replace spawning gravels and habitat in the Mokelumne River, using natural processes (i.e. river flows) to distribute the gravel.
Entrainment	Apply similar restoration actions to those cited for Suisun Marsh and Delta.
	Screen and redesign Stockton East diversion on the Calaveras River.
	Rehabilitate and enlarge Woodbridge screen bypass pipe on the Mokelumne River.
Habitat fragmentation	Fund efforts to secure and restore riparian corridors on the Cosumnes and Mokelumne rivers.
	Evaluate feasibility of removing checkdams on the Calaveras and Cosumnes rivers.
	Initiate a replanting program for cottonwood, valley oak, and other large riparian species.
	Implement a landowner education program for impacts of land management activities on SRA.
Flow constraints	Evaluate feasibility of restoring anadromous fish on lower reaches of the Calaveras River.
	Conduct an instream flow study, including all life stages, of the lower Calaveras River for possible anadromous fish use.
	Evaluate conjunctive use possibilities for water supply on the Mokelumne River.
	Study and provide channel maintenance flows, including adequate coarse sediment supply, and fine sediment transport on the Mokelumne and Calaveras rivers.

TABLE 8. STRESSORS AND POTENTIAL RESTORATION ACTIONS FOR ALL DELTA REGIONS (DELTA, SUISUN MARSH, AND EASTSIDE TRIBUTARIES).

Stressor Category	**Potential Restoration Action**
Exotic species	Education program to encourage native plant use in landscaping.
Water quality	Provide subsidies for alternatives to pesticides (especially Diazinon), including those used for aquatic weed control.
	Expand and broaden BIOS program funded under Category III.
	Identify contaminant sources and remediate them.
	Establish control and management program to limit Diazinon use.
	Implement watershed management activities to reduce sedimentation and contaminants from urban and agricultural sources.
	Encourage grading ordinances and enforcement by RWQCB.
	Increase upstream water quality monitoring (refer to Water Quality Technical Team).
	Implement user fees to limit contaminants.
	Support watershed groups in education efforts.
	Expand funding to identify contaminants causing toxicity.
	Establish a cooperative program to decrease selenium and other contaminant loads.

APPENDIX A

Workshop Agenda and Attendee List

D-026943

DRAFT

Delta, Suisun Bay, and East Side Tributaries Technical Team Meeting

AGENDA

Date: March 31 and April 1, 1997

Time: 9:00 to 5:00 each day

Location
To Be Determined

Monday, March 31

9:00 - 9:15	**Introductions** (Eugenia Laychak)
9:15 - 9:45	**History/Overview of Area** (To be announced)
9:45 - 10:15	**Overview of Meeting Purpose, Scope, Process and Goals/Objectives of CALFED Bay-Delta Program, CVPIA and other programs** (Cindy Darling)
10:15 - 10:30	**Break**
10:30 - 12:00	**Break Out Groups -Identify Stressor and Limiting Factors on Priority Species and Habitat Types** (Eugenia Laychak and participants)
12:00 - 1:00	**Lunch**
1:00 - 5:00	**Prioritize Stressors and Limiting Factors** (Eugenia Laychak)

Tuesday, April 1

9:00 - 10:30	**Identify Types of Actions Needed to Address Stressors** (Eugenia Laychak)
10:30 - 10:45	**Break**
10:45 - 12:00	**Finish Identifying and Prioritze Types of Actions** (Eugenia Laychak)
12:00 - 1:00	**Lunch**
1:00 - 3:00	**Present Information from Break Out Groups and Reach Consensus on Package of Projects and Programs**
3:00 - 3:15	**Break**
3:15 to 4:30	**Complete 1:00 Agenda Item**
4:30 - 5:00	**Wrap Up**

Attendee List

Delta, Suisun and East Side Tributaries Technical Team
March 31 - April 1, 1997
Jean Harvie Community Center, Walnut Grove

Name	Affiliation	Phone number
Dennis Becker	Dept. Of Fish & Game	(707) 425-3828
Serge Birk	CVPWA	(916) 529-4334
Pat Brandes	USFWS	(209) 946-6400
Pat Brantley	DFG BAY/DELTA	(209) 942-6069
Dan Castelberry	USFWS-AFRP	(209) 946-6400
Steven Chapell	Suisun Resource Conservation District	(707) 425-9302
Cindy Darling	CALFED	(916) 653-5950
Greg Elliott	National Fish & Wildlife Federation	(916) 484-1290
Steve Ford	DWR	(916) 327-7534
Rod Fujita	EDF	(510) 658-8008
Tom Hampson	Fishery Foundation of California	(510) 944-9115
Kate Hansel	CALFED	(916) 653-1103
Roger Hartwell	EBMUD	(510) 287-2025
Susan Hatfield	EPA	(415) 744-1994
Elise Holland	Delta Bay Institute	(415) 721-7680
Waldo Holt	San Joaquin Audubon Society	(209) 462-4438
Liz Howard	USBR	(916) 979-2926
Bill Kier	Kier Associates	(415) 331-4505
Robert Koenigs	USACOE	(916) 557-6712
David Kohlorst	DFG	(209) 948-7080
Kathryn Kuivila	USGS	(916) 278-3054
Eugenia Laychak	CCPDR	
Lee Lehman	Suisun Resource Conservation District	(707) 425-9302

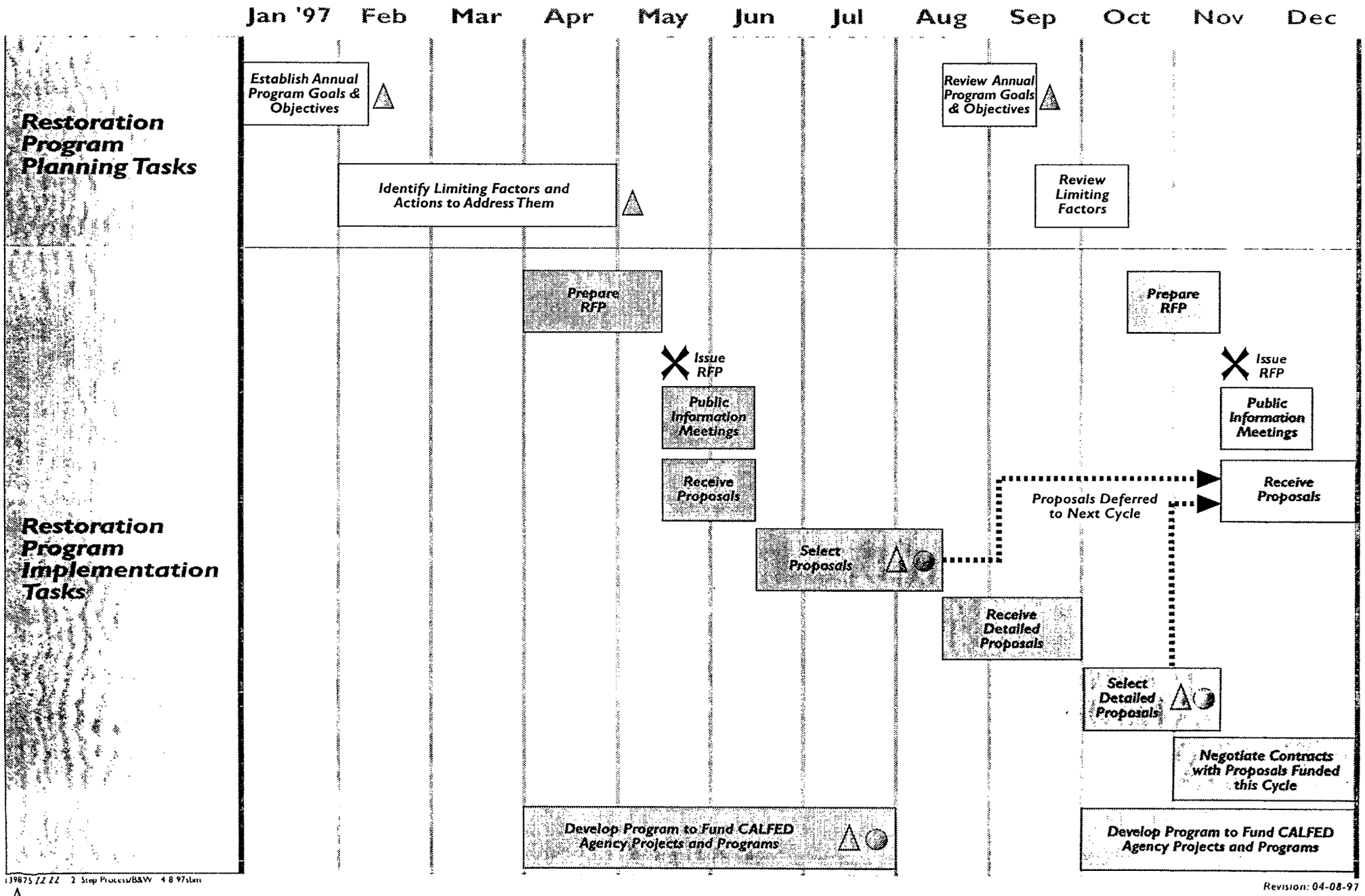
D-026945

Ken Lentz	USBR	(916) 970-2978
Ed Littrell	Dept. Of Fish & Game	(916) 358-2924
Greg Martinelli	Suisun Resource Conservation District	(707) 425-9302
Heather McIntire	DFG	(209) 948-7800
Joe Miyamoto	EDMUD	(510) 287-2021
Kent Nelson	DWR	(916) 227-7577
Bob Nuzum	EBMUD	(510) 287-0407
Dan Odenweller	DFG, Inland Fisheries Division	(916) 654-2731
Brad Orson	East Bay Regional Park District	(510) 635-0138 ext. 2622
Bob Pine	CALFED-FWS	(916) 653-2641
Tim Ramirez	Tuolumne River Trust	(415) 292-3631
Rich Reiner	TWC	(916) 684-4012
Pete Rhoads	MWDSC	(916) 650-2620
David Schoellhamer	US Geological Survey	(916) 278-3126
Scott Spaulding	USFWS	(209) 946-6400
Beth Stone	East Bay Regional Park District	(510) 635-0138 ext 2625
Ramona Swenson	City of San Francisco (Trihey & Assoc.)	(510) 689-8822
Martha Turner	CCPDR	
Dave Vogel	NCWA & SJTA	(916) 527-9587
Katie Wadsworth	DWR	(916) 227-0180
Frank Wernette	DFG	(209) 948-7800
Scott Wilcox	CALFED Consultant Staff (EA)	(916) 924-7450

APPENDIX B

CALFED Planning Process, and Priority Species and Habitats

CALFED Restoration Coordination Planning Process



Revision: 04-08-97

A = Roundtable Recommendations

CALFED Decision Point

D-026948

D—026948

under the federal Endangered Species Act and a candidate for listing under the State Endangered Species Act. The Sacramento splittail also supports a small winter sport fishery in the lower Sacramento River.

6. *Steelhead trout:* The steelhead trout is an important native anadromous sport fish of high recreational and ecological value that is proposed for listing under the federal Endangered Species Act.

7. *Green sturgeon:* The green sturgeon is designated as a species of special concern by DFG and a species of concern by USFWS.

8. *Striped bass:* The striped bass is an important non-native anadromous sport fish with high recreational value. It also plays an important role as a top predator in the aquatic system.

9. *Migratory Birds*: Includes both waterfowl guild and neotropical migratory bird guild. Many of these species migrate through, winter or breed in the Bay-Delta. Waterfowl are a significant component of the ecosystem, are of high interest to recreational hunters and bird watchers, and contribute to California's economy. Representative species include canvasback, mallards, and snow geese. The neotropical migratory bird guild are of high interest to recreational bird watches and there have been substantial losses of habitat used by these species.

VI. *GEOGRAPHIC DISTRIBUTION OF PRIORITIES*

The geographic distribution of the five habitat types and the eight species or population priorities are shown in Table 1 and 2. Using these habitat types and species as priorities will result in a fairly broad geographic distribution of projects and resources. Therefore, no additional geographic priorities have been established at this time.

Table 1. Geographic Distribution of Priority Habitat Types

	North Bay	Delta	Sacramento	Sacramento Tributaries	San Joaquin	San Joaquin Tributaries
Tidal Freshwater		x				
Seasonal floodplain wetlands	x	x	x	x	x	x
Shaded Riverine	x	x	x	x	x	x
Saline Tidal/ emergent	x					
Mid-channel islands		x				
Instream Aquatic Habitat			x	x	x	x

Table 2. Geographic Distribution of Priority Species Likely Actions to Address									
	North Bay	Delta	Sacramento	American	Feather/ Yuba	smaller tributaries	San Joaquin	San Joaquin Tributaries	Ocean
San Joaquin Fall Run		x					x	x	x
Winter Run		x	x						x
Spring Run		x	x		x	x			x
delta smelt	x	x	x						
splittail	x	x	x				x	x	
steelhead	x	x	x	x	x	x	?	?	x
green sturgeon	x	x	x						x
striped bass	x	x	x				x		x
Migratory birds	x	x	x	x	x	x	x	x	

APPENDIX C

General Session Presentation on the Mokelumne River by Joe Miyamoto

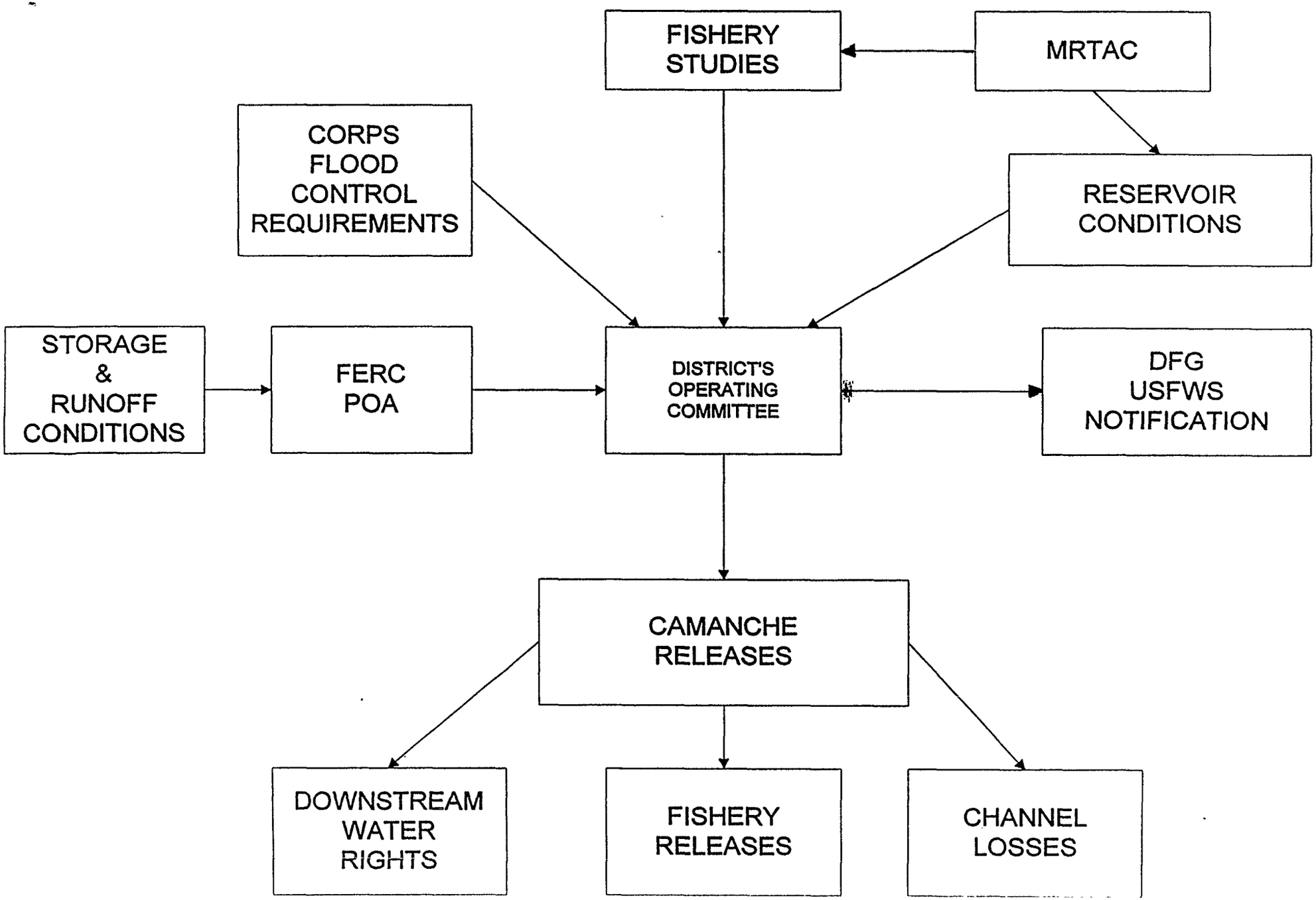
INTRODUCTION

The lower Mokelumne River drains a watershed of some 661 square miles. The average unimpaired runoff is 720,000 AF, with a range of 129,000 to 1.8 MAF. Major storage reservoirs in the system include Camanche, Pardee, and Salt Springs Reservoirs. Below Camanche Reservoir, Woodbridge Irrigation District operates an irrigation diversion dam near the City of Lodi. Approximately 60 riparian and appropriative water rights holders withdraw water for irrigation purposes.

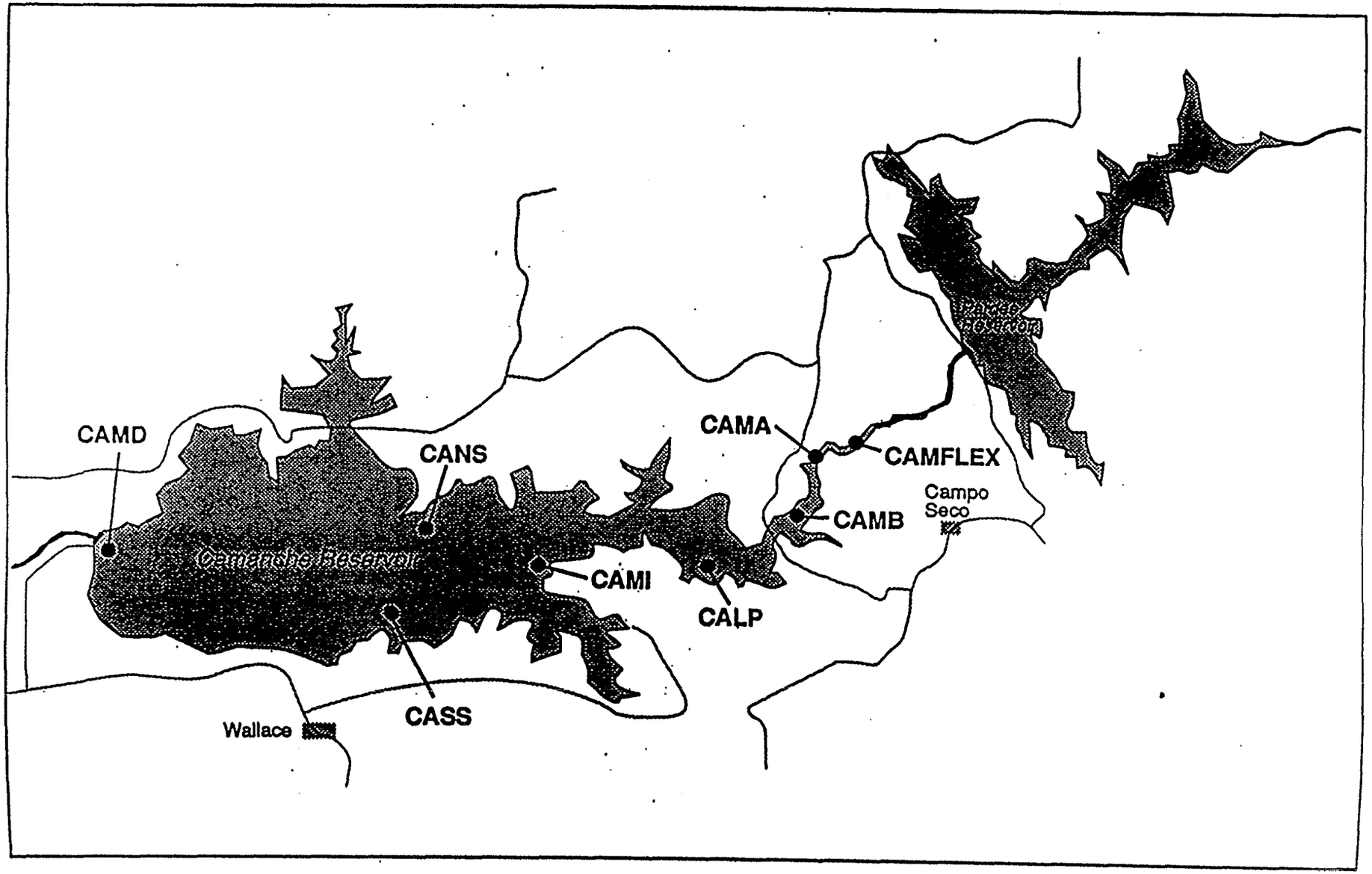
The Mokelumne River below Camanche Reservoir supports both hatchery and natural runs of fall chinook salmon and steelhead. Both striped bass and American shad are present in the Mokelumne River below Woodbridge Dam.

The Mokelumne River Fish Hatchery is located below Camanche Dam and produces three to four million fall chinook salmon smolts, 0.5 yearlings, and 100,000 steelhead yearlings. The hatchery was constructed in 1964 to mitigate for the lost habitat above Camanche Dam. Historically, salmon and steelhead could migrate upstream to the Arkansas Ferry Crossing located at the upper end of Camanche Reservoir.

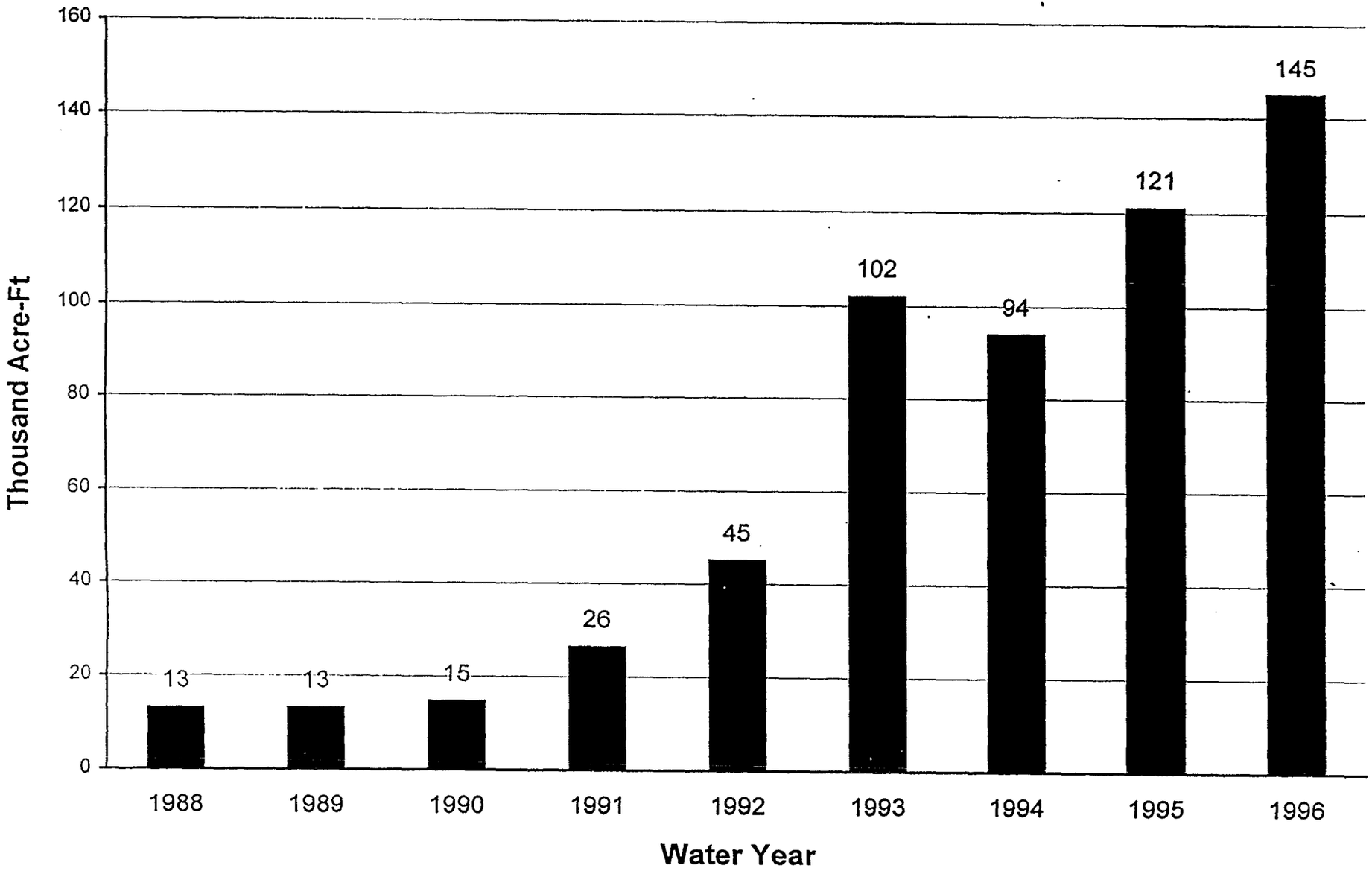
MOKELUMNE RIVER OPERATIONS



Camanche Reservoir Sample Stations

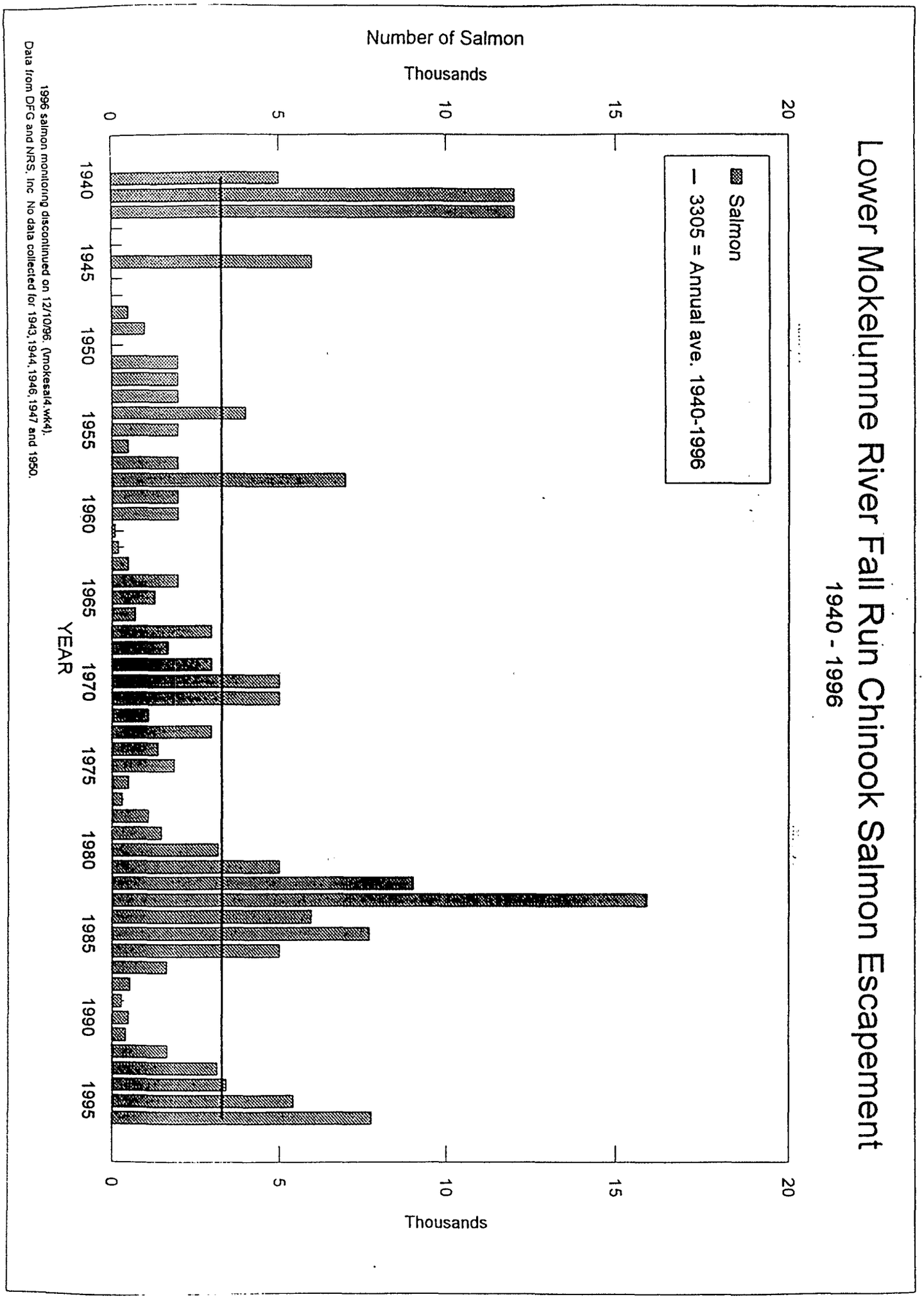


Portion of Camanche Release Dedicated Solely to Fishery



NOTES:

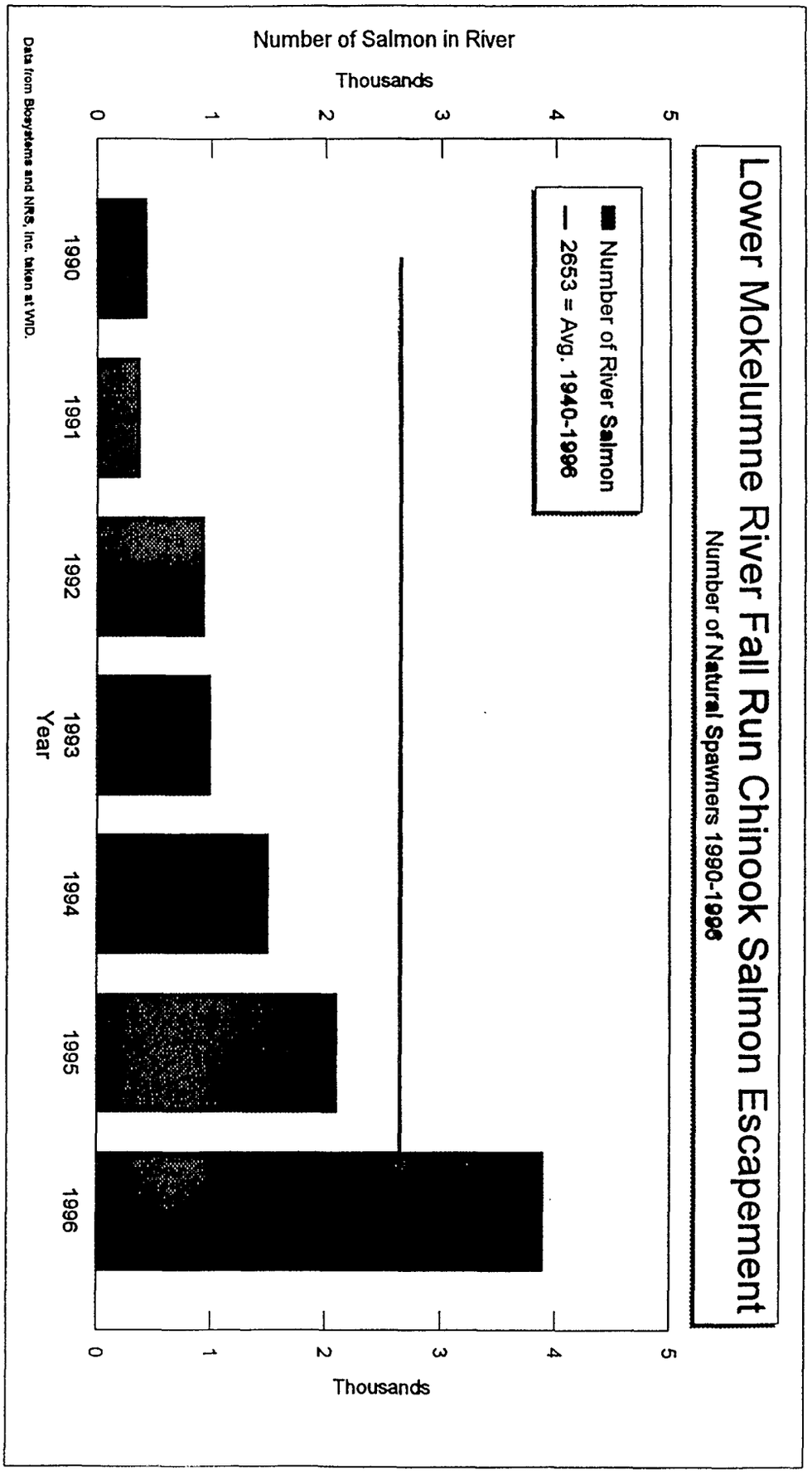
- Voluntary operations in conformance with the District's Lower Mokelumne River Management Plan began in water year 1993.
- Operation in conformance with Principles of Agreement with Resource Agencies began March 8, 1996.
- 5.1 TAF transferred from water year 1994 for use in water year 1995
- Additional water released for flood control purposes during water years 1993, 1995, and 1996



D-026956

D-026956

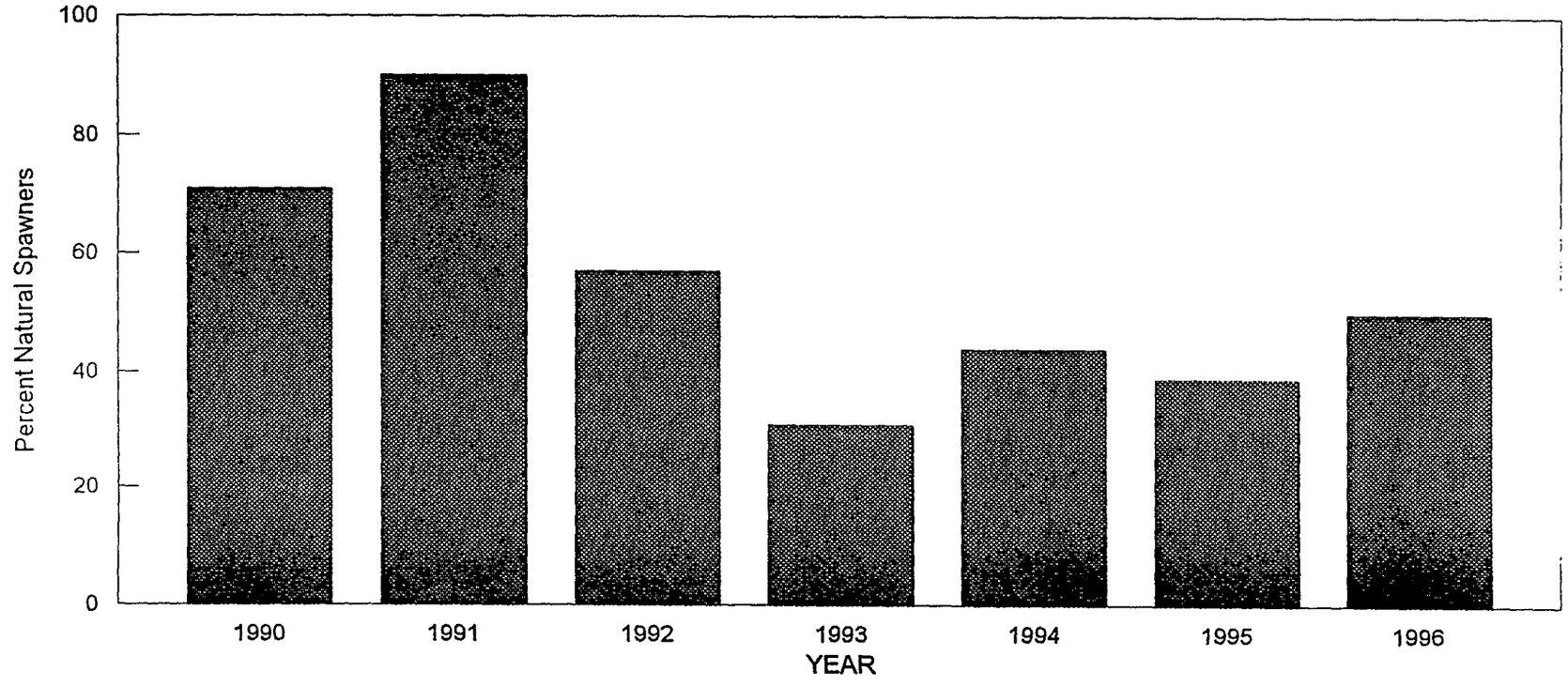
NZHNSN.WK4



D-026957

Lower Mokelumne River Fall Run Chinook Salmon Escapement

Percentage of Chinook Salmon Spawning Naturally in the Mokelumne River



Data from Biosystems and NRS, Inc. taken at WID.

NZHNSN.WK4

EBMUD

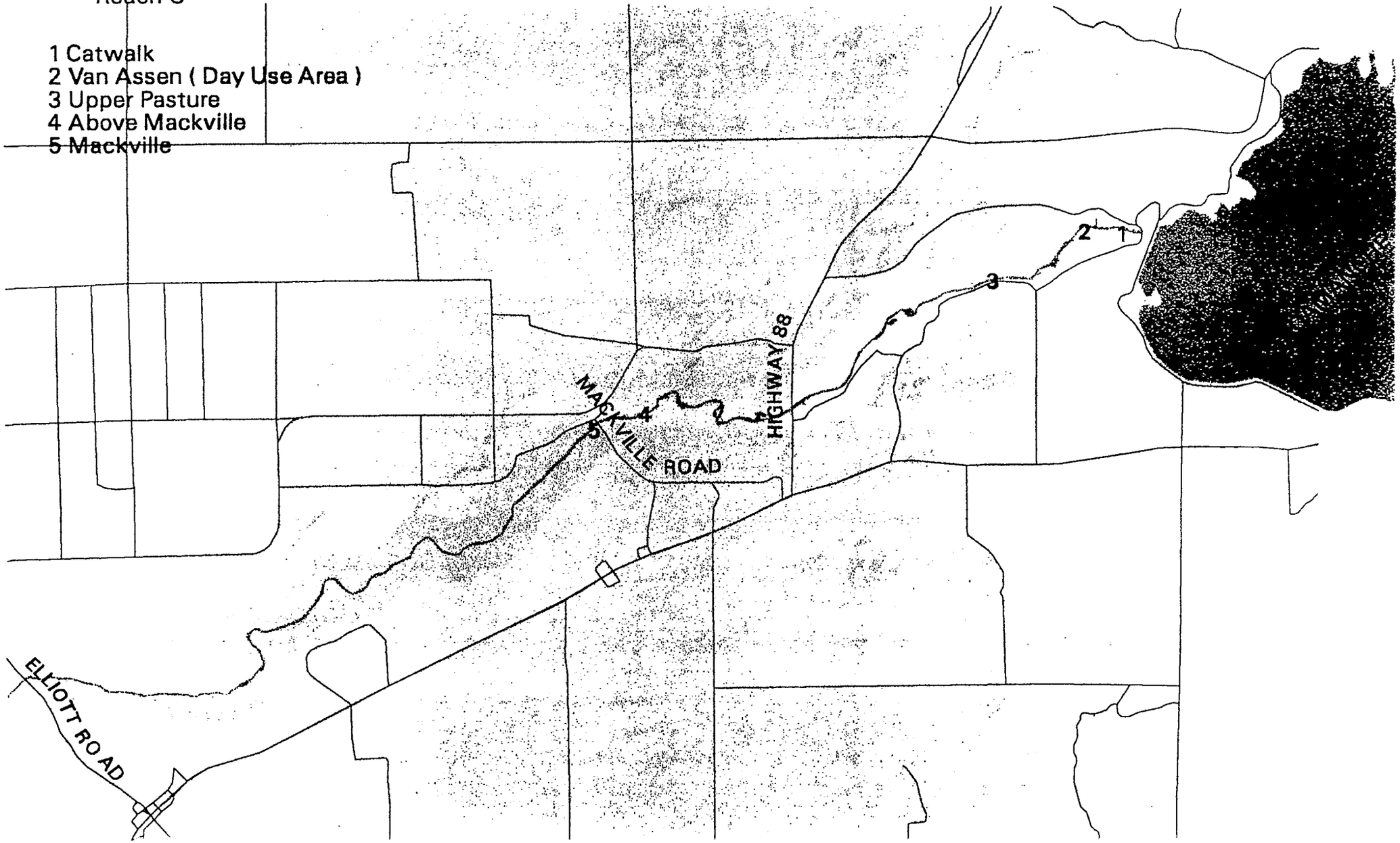
ANNUAL RIVER MONITORING COMPONENTS

- Daily monitoring of stream flow, water temperature, barometric pressure, lunar cycle, weather, precipitation, turbidity and Delta hydrology
- Daily upstream migration counts (Salmon and Steelhead) - Woodbridge Dam
- Weekly redd (nest) surveys - Three river reaches (Camanche Dam to Hwy. 88, Hwy. 88 to Mackville Rd., Mackville Rd. To Elliott Rd.)
- Seasonal surveys for potential redds between Elliott Rd. And WID
- Substrate composition of spawning gravels (Nov - March)
- Annual monitoring of spawning gravel enhancement sites

Lower Mokelumne River - Seining Sites

Reach A
Reach B
Reach C

1 Catwalk
2 Van Assen (Day Use Area)
3 Upper Pasture
4 Above Mackville
5 Mackville



EBMUD

ANNUAL RIVER MONITORING COMPONENTS

- Biweekly fry rearing surveys (Jan - March)
- Daily fry outmigration counts - Woodbridge Dam (Feb - March)
- Biweekly smolt rearing surveys (April - July)
- Daily smolt outmigration counts - Woodbridge Dam (April - July)
- Radio telemetry studies of in-river/Delta migratory movements (June-Nov)
- Salmon smolt and yearling physiology
- Coded wire taggging hatchery and natural smolts

D—026961

EBMUD

KEY RESEARCH FINDINGS

- Less than optimum spawning and incubation temperatures can occur with high reservoir levels
- More salmon migrate out as fry during wet water years
- Spring pulse flows do not appear to stimulate the movement of salmon smolts
- Usage of salmon gravel enchancement sites increases with time
- Earlier outmigrating salmon smolts demonstrate better survival than later outmigrating fish
- Adult salmon prefer to spawn near gravel berms and in non-bermed areas with large woody debris

EBMUD

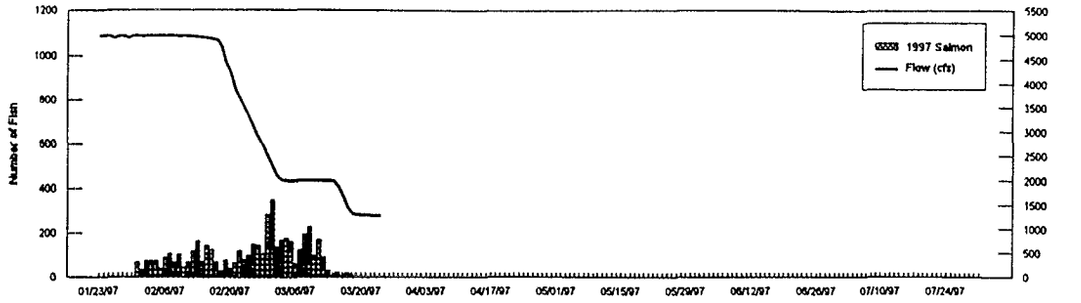
KEY RESEARCH FINDINGS

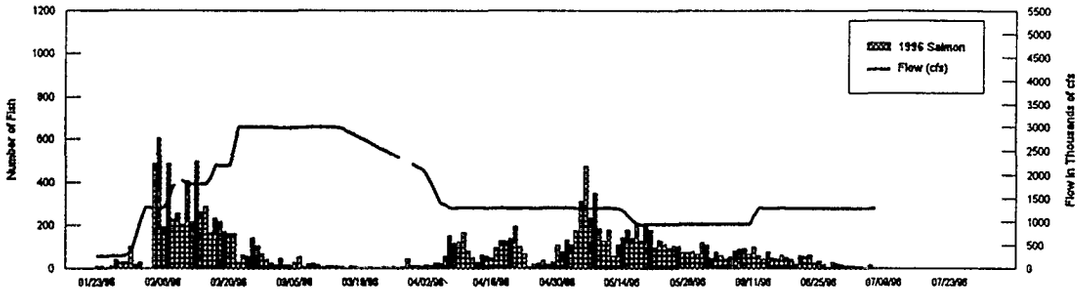
- Striped bass have been shown to be a significant predator on juvenile salmonids below WID.
- Superimposition increases with increasing escapement
- Spawning in river has increased with increasing escapement; return to the hatchery generally increases with increasing escapement. (Hatchery return did not increase in 1994)

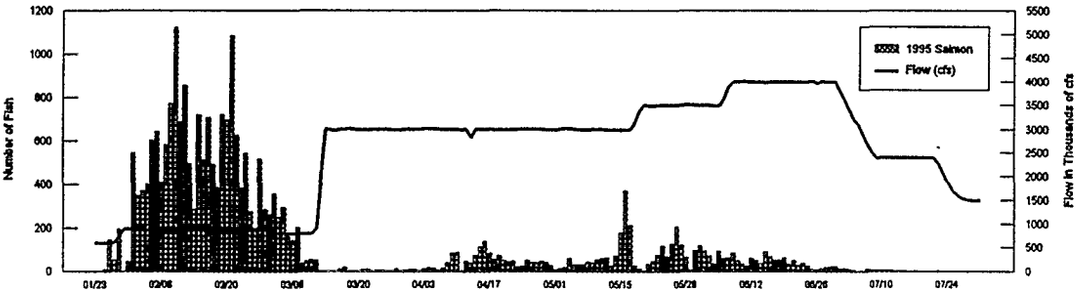
D—026963

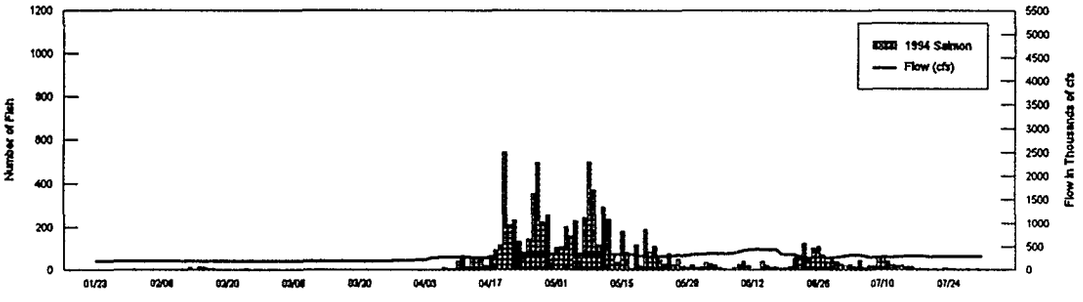
Lower Mokelumne River Chinook Salmon Emigration

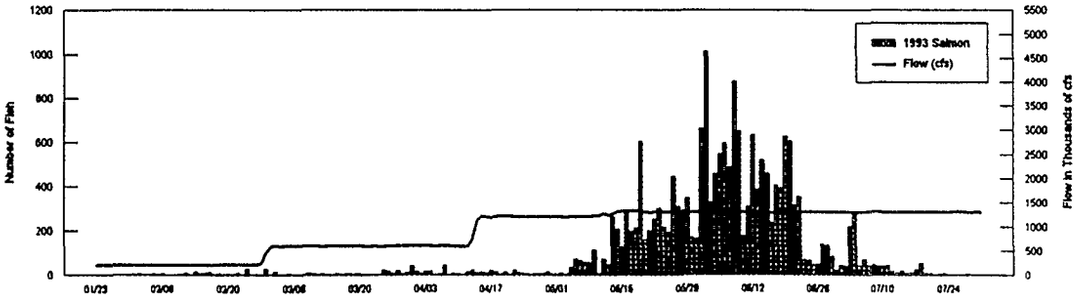
Traps at Woodbridge Irrigation Dam (base data from NRS, Inc.): 1993 - 1997







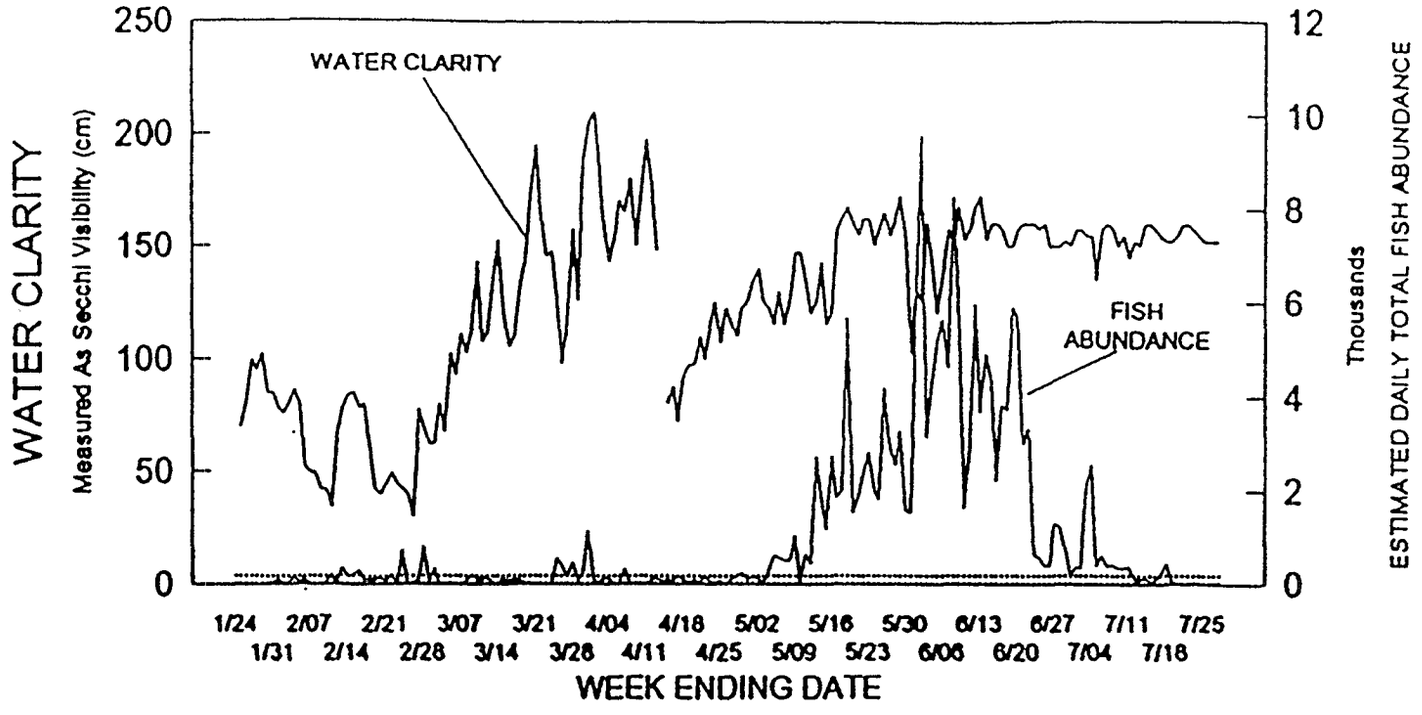




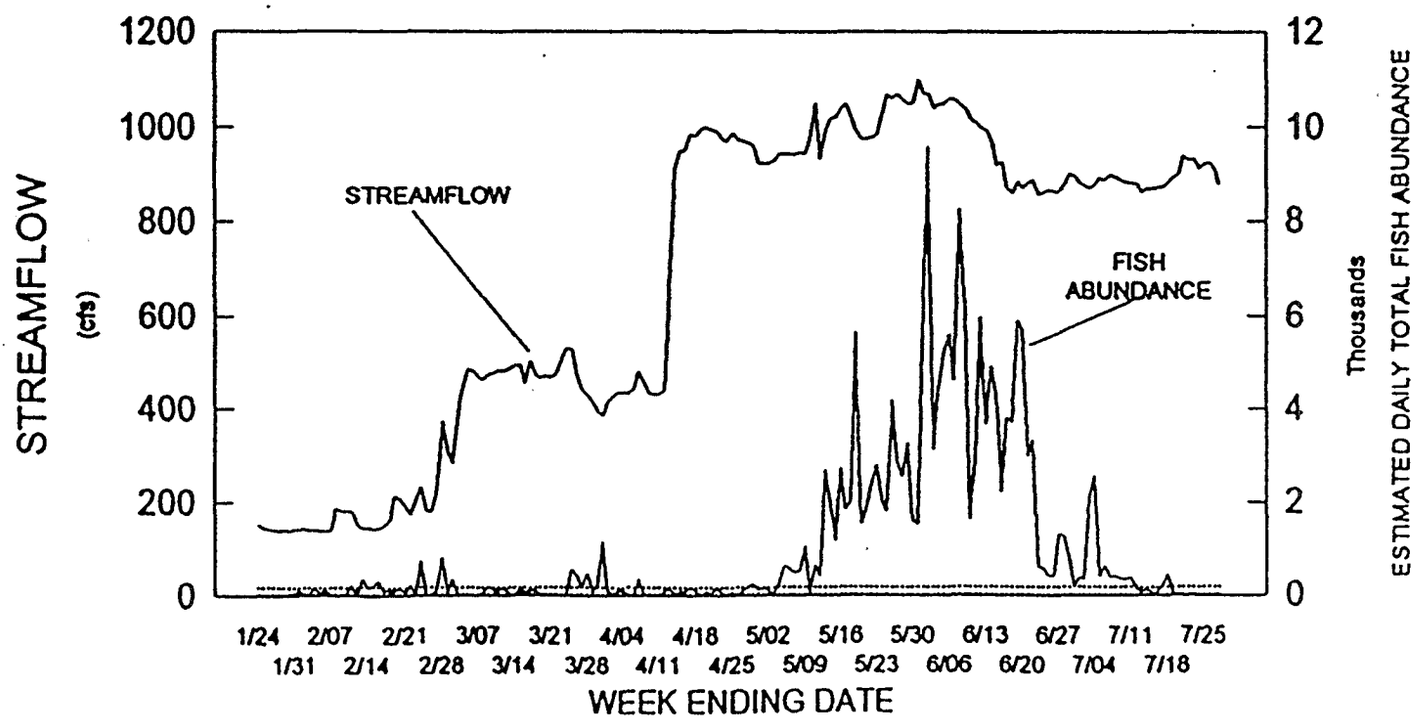
In 1986, high flows have caused disruptions in screw traps
High flows may result in problems with trapping efficiency tests
Salmon numbers reflect actual captures not estimates

97SITKO.WK4

WOODBRIDGE DAM SITE



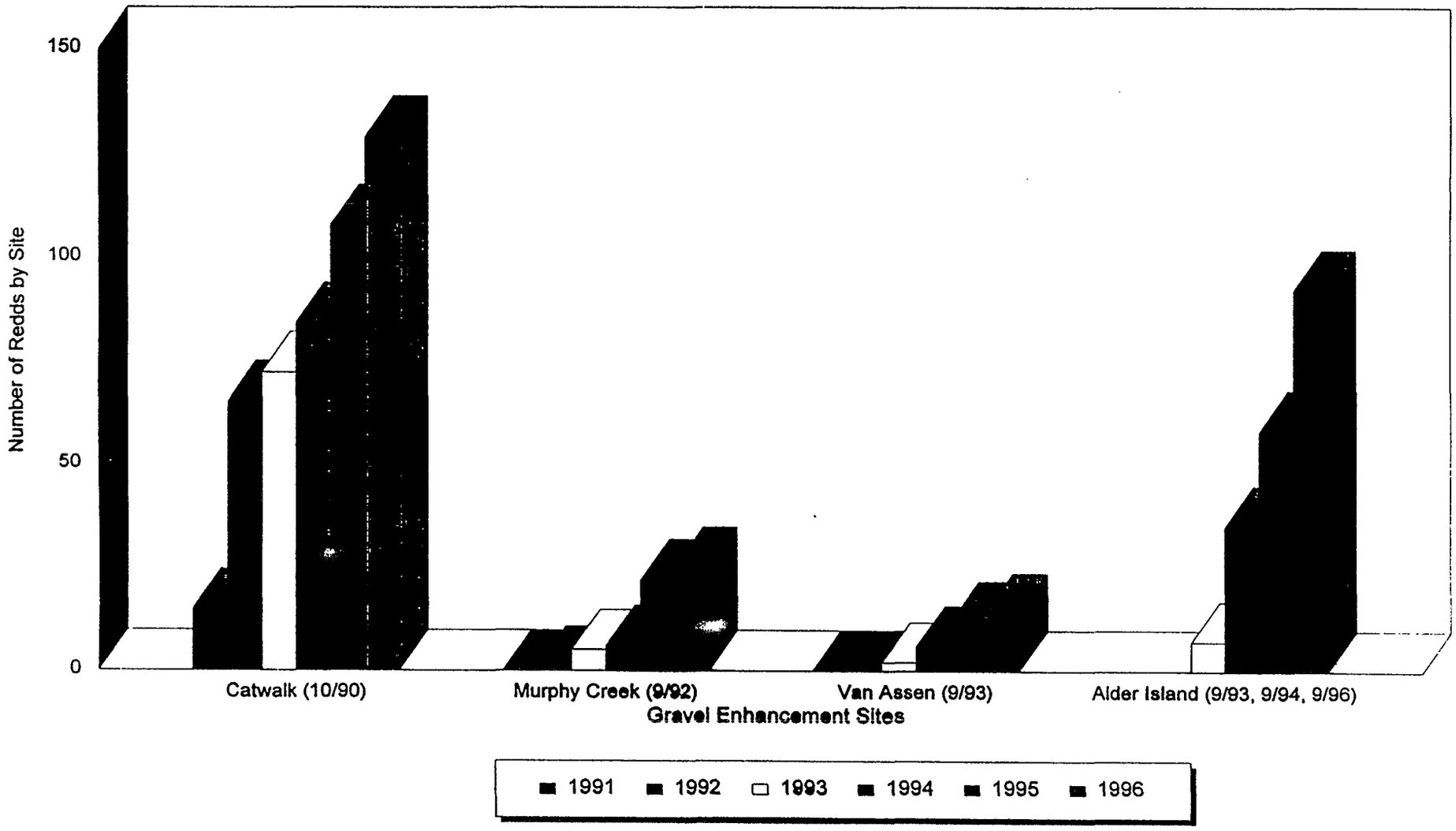
WOODBRIDGE DAM SITE



D-026965

Gravel Enhancement Area Usage 1991-1996

Lower Mokelumne Fall Run Chinook Salmon

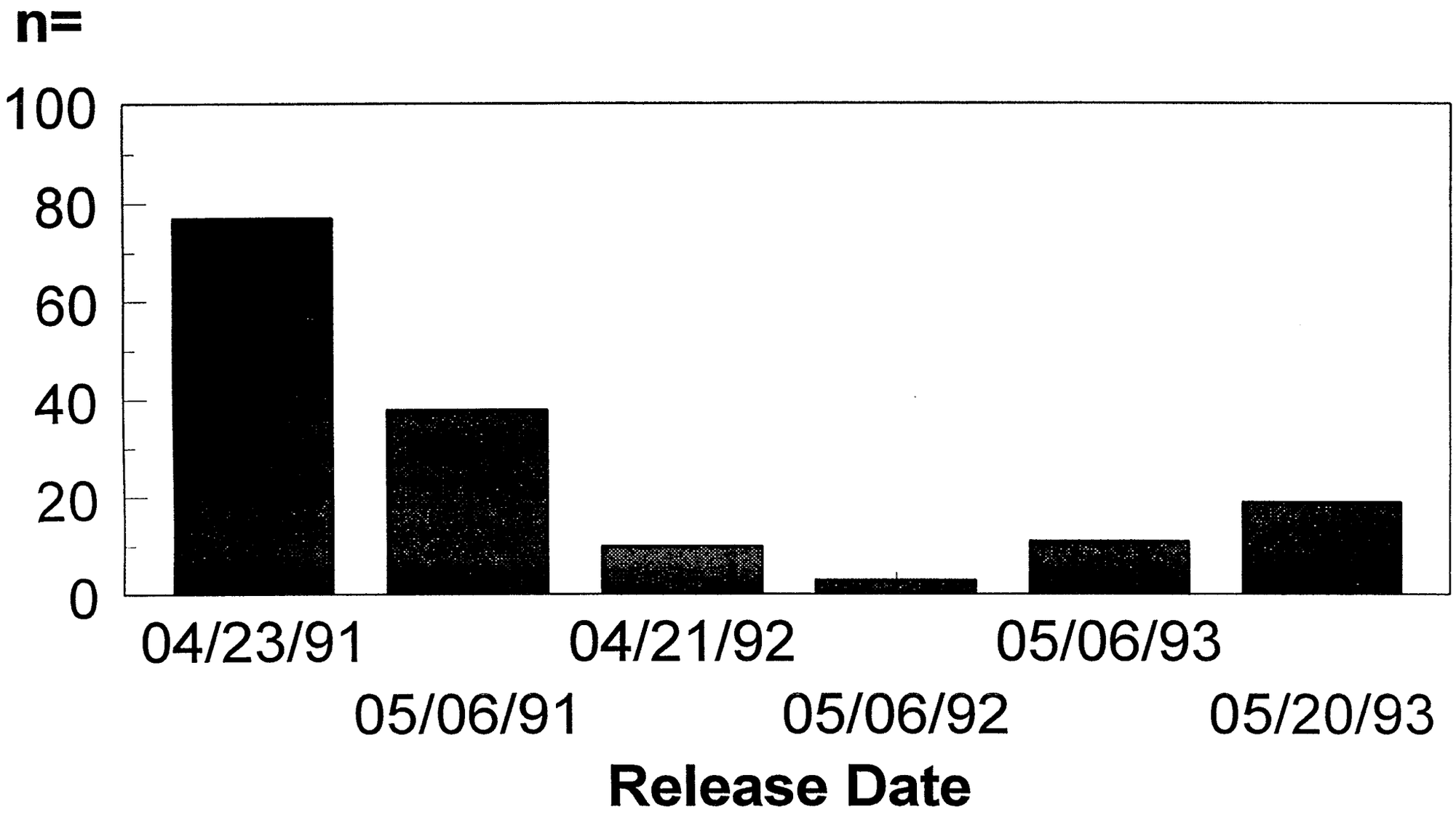


Date of Enhancement in Parenthesis

96FIG15.WK4

Delta Mortality Study

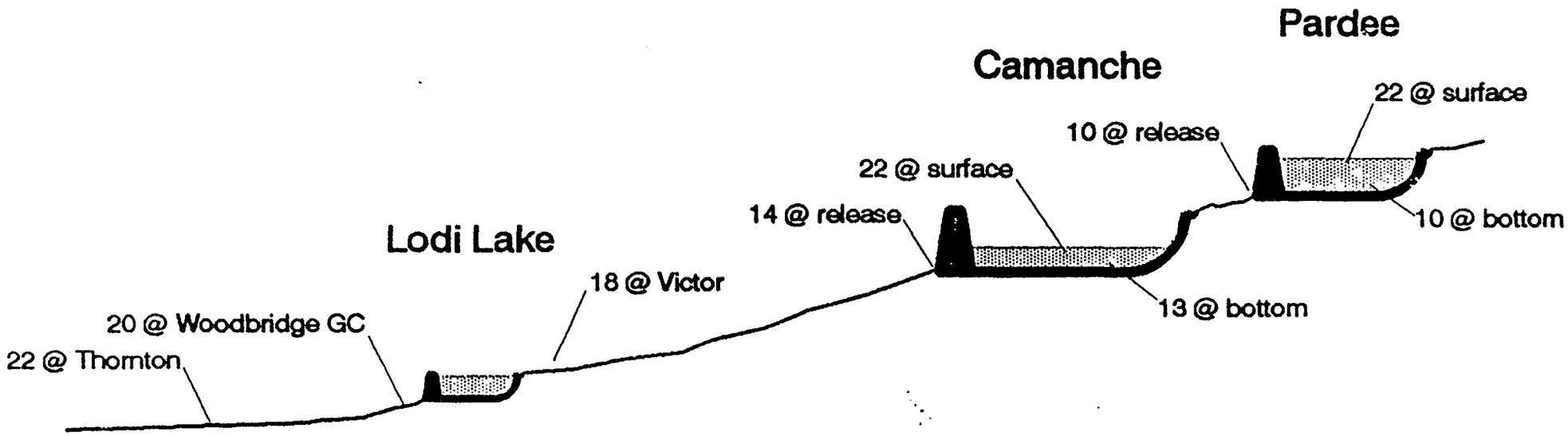
Adult Recoveries



Hatchery and River Recoveries Pooled

River Recoveries not Expanded to Reflect Effort

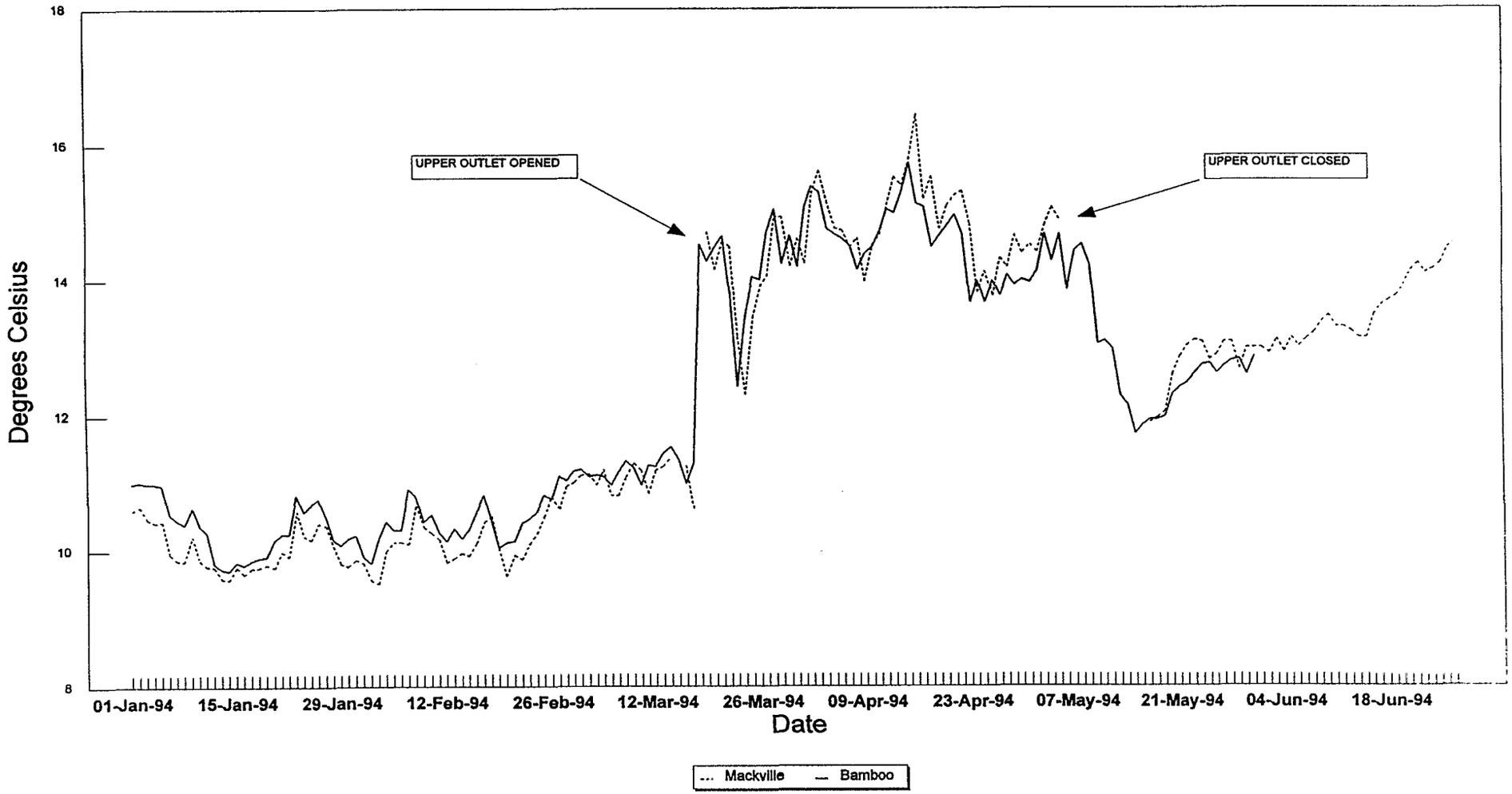
Mokelumne System Temperatures (°C)
on July 1, 1992



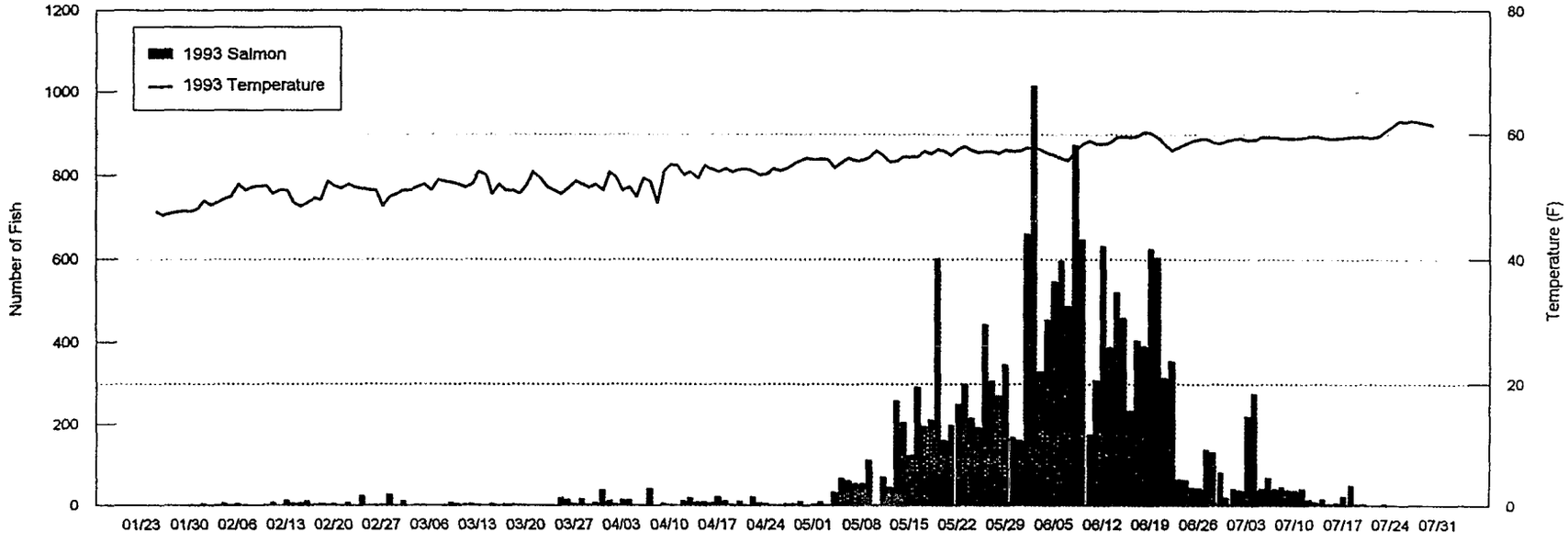
moktemp.drw
9/8/92

Lower Mokelumne River 1994 Average Temperatures

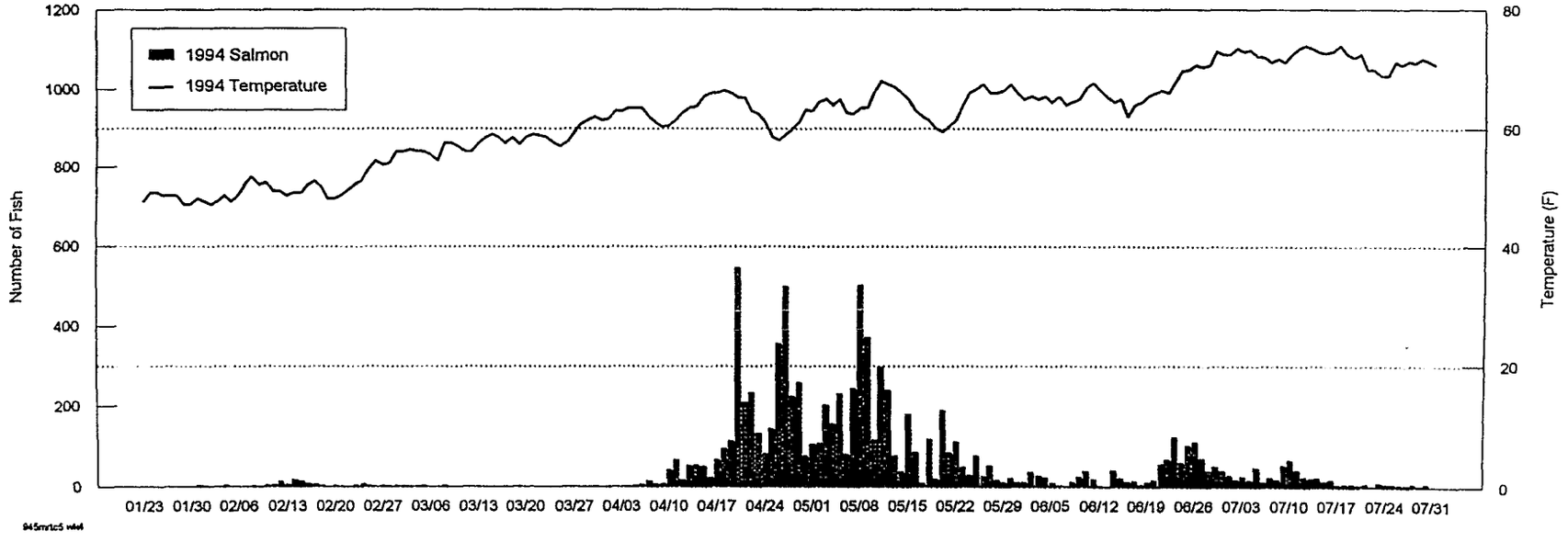
Bamboo & Mackville Road



Lower Mokelumne River Fall Run Chinook Salmon Outmigration 1993

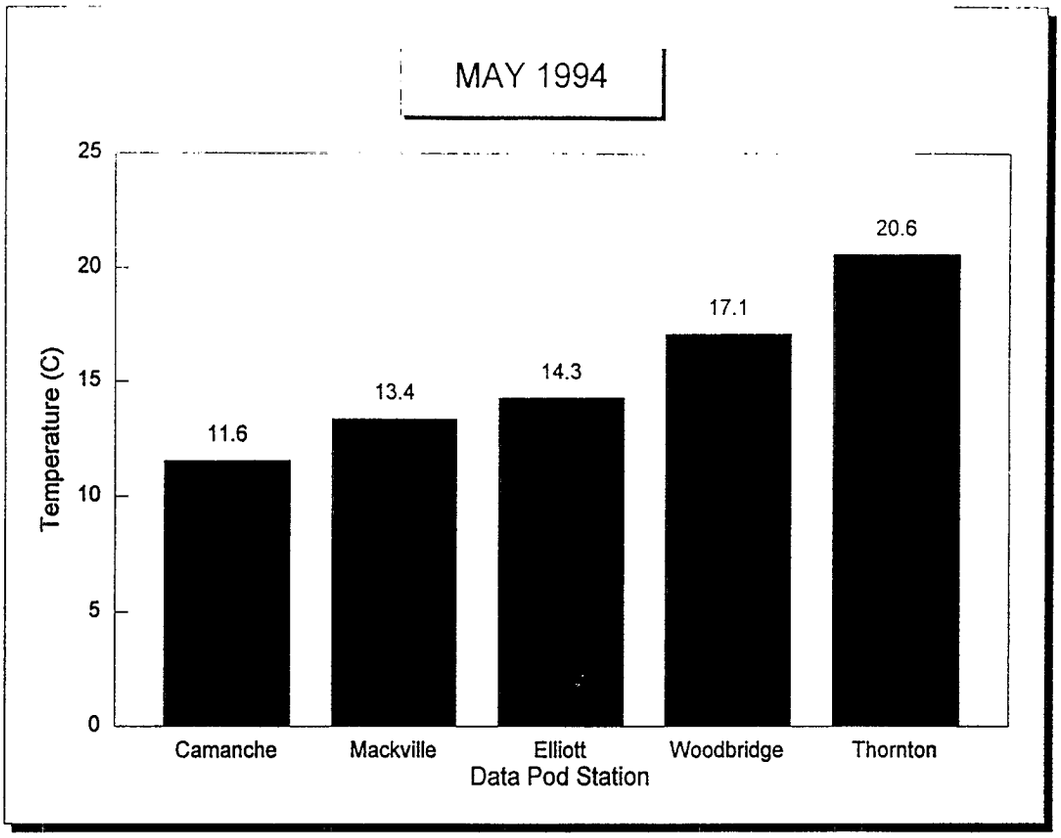


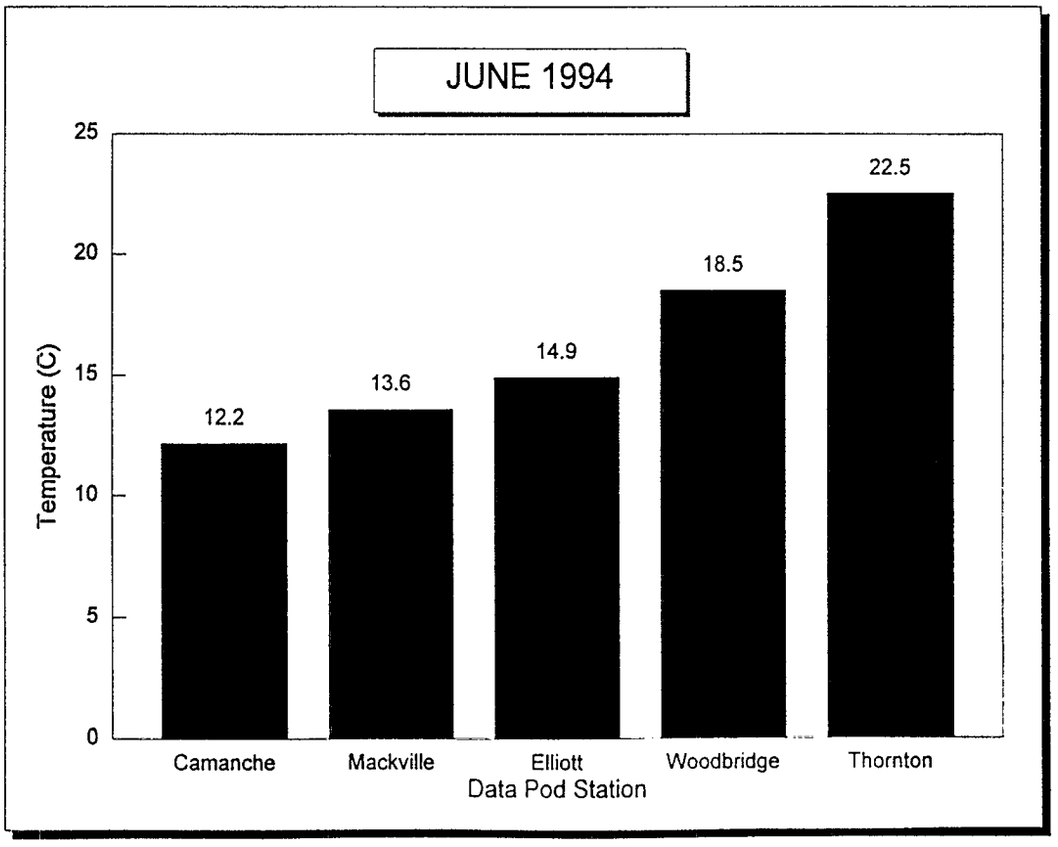
Lower Mokelumne River Fall Run Chinook Salmon Outmigration 1994



945mrlc5 mk4

1994 MOKELUMNE RIVER WATER TEMPERATURES





TN0694.WK4

Lower Mokelumne River Fall Run Chinook Salmon Superimposition of Redds 1991-1996

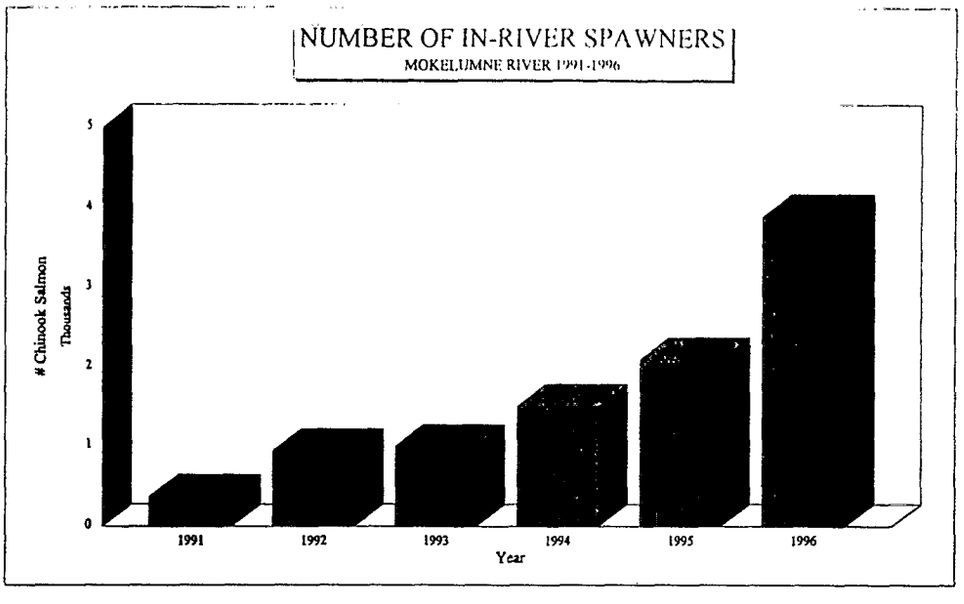
Year	Number of River Spawners	Number of Redds	Total Superimposed Redds*	Percent Superimposed Redds	Percent Redds in Enhancement Gravel
1991	316	127	1	1	12
1992	416	343	6	2	19
1993	730	530	16	3	15
1994	1,294	774	107	14	13
1995	2,105	888	120	14	17
1996	3,892	1,284**	158	17	24

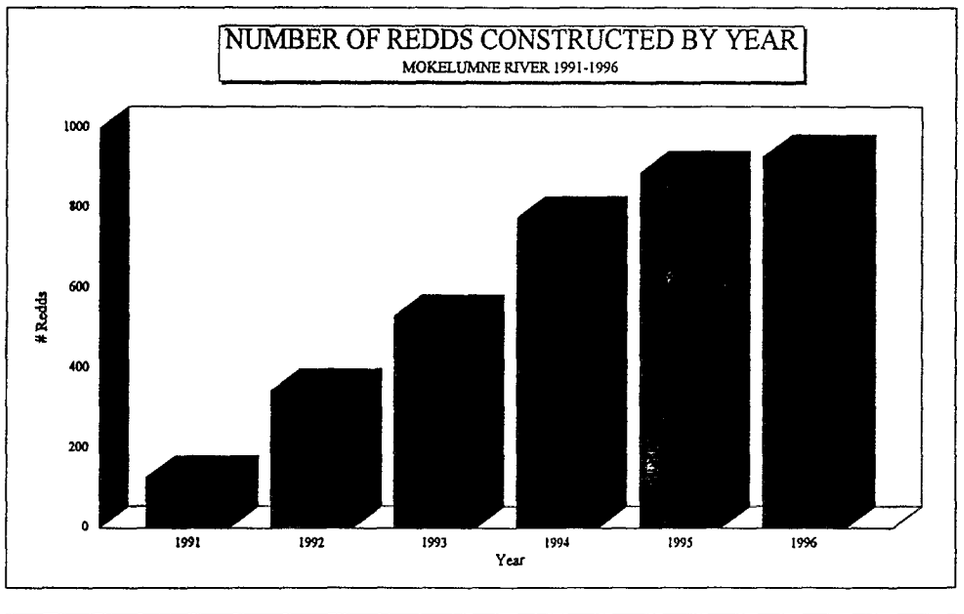
* Egg-pockets estimated superimposed 25% or greater at time of survey.

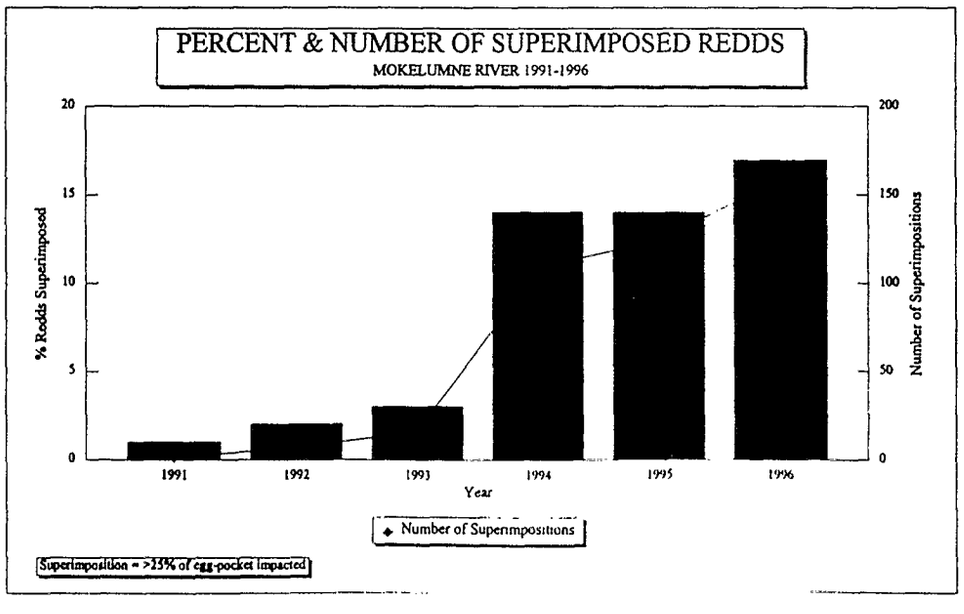
** 929 redds were observed through the first week of Dec. 1996 when redd surveys were discontinued due to high flows. 1284 (+/- 8.1%) is an estimate based on total 1992-1995 end-of-run average added to the observed number.

Because high flows altered other gravel enhancements, only redds built in the 1990, 1992, upper 1993 and 1996 gravel enhancements are reported.

\916redd.wk4





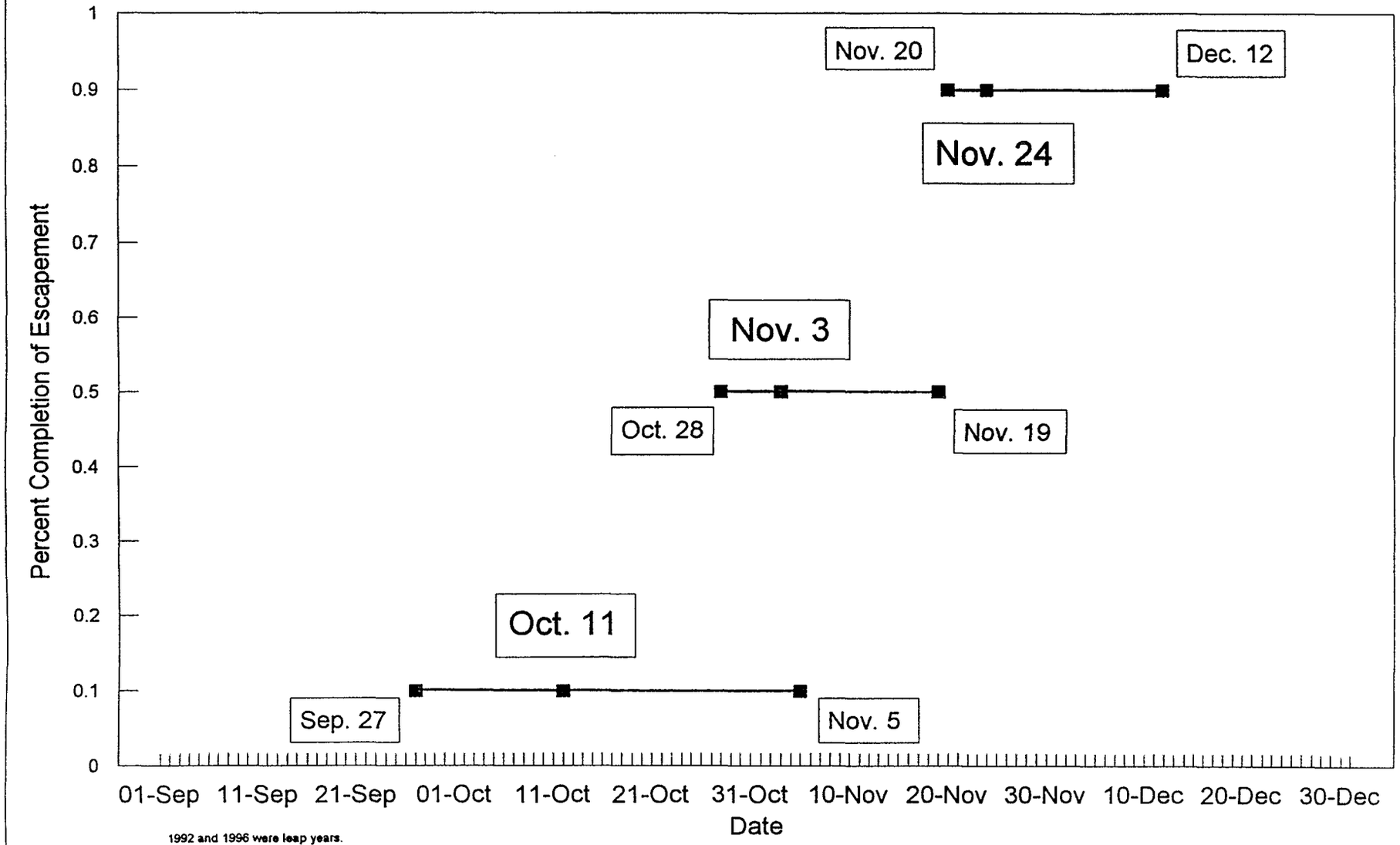


MRTAC.WK4

D-026973

Lower Mokelumne River Fall Run Chinook Salmon Escapement

Range and Mid-point of 10%, 50%, and 90% Completion of Run Dates 1990 - 1996

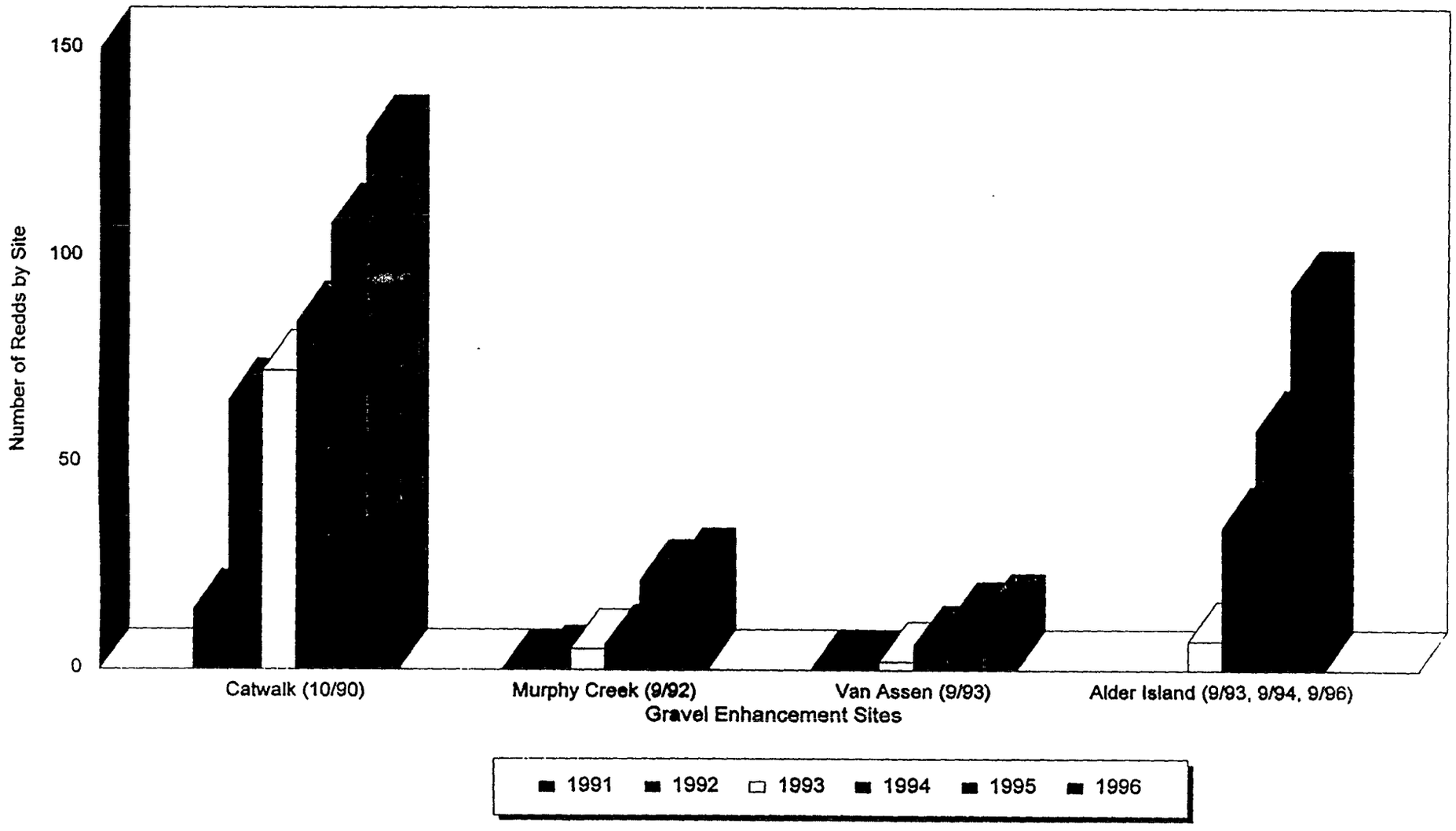


1992 and 1996 were leap years.
Data from Biosystems and NRS, Inc. Start/stop Monitoring dates have varied.

INOUT97F.WK4

Gravel Enhancement Area Usage 1991-1996

Lower Mokelumne Fall Run Chinook Salmon



Date of Enhancement in Parenthesis

96FIG15.WK4

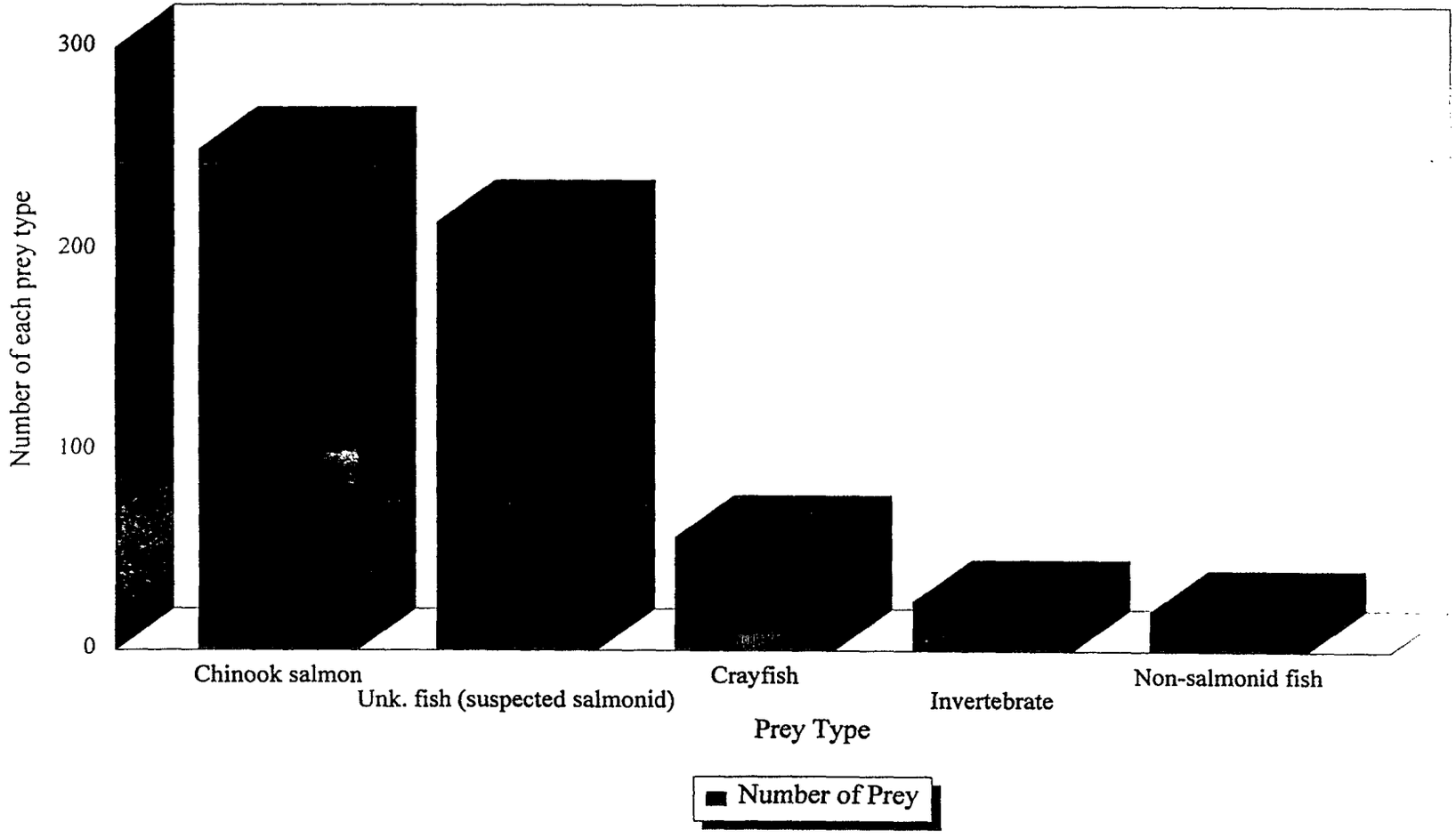
PERCENTAGE OF REDDS CONSTRUCTED ON BERMS AND ASSOCIATED WITH LOD 1991-1996

Year	Total Redds	No. on berms	% on berms	% LOD	% Superimposition	Flow (cfs)
1991*	127	90	71%	N/A	1	160-200
1992*	345	209	61%	N/A	2	160-200
1993*	530	138	26%	34%	3	300-400
1994*	773	156	20%	22%	14	250
1995*	888	504	57%	10%	14	270
1996*	929	597	64%	12%	17	325-3000

* Hartwell, 1992, 1993, 1994, 1995, respectively

STOMACH CONTENTS OF STRIPED BASS

CAPTURED BELOW WOODBRIDGE DAM, MOKELUMNE RIVER SPRING 1993



N=120
EBMUD & CDFG Study

PREDWID.WK4

EBMUD

EBMUD/WID JOINT AFRP FISH PASSASGE IMPROVEMENTS

- A gated system for releasing water from the dam could be constructed to enable greater control of downstream flows and water temperatures.

- Weir boards could be used at the base and between vents of Woodbridge Dam to create plunge pools that would lessen any physical injury to juvenile salmonids passing over the spill.

- The bypass entrance and pipeline at the fish screens should be enlarged. This would increase the attraction flows to the bypass for outmigrants and increase sweeping velocities across the fish screens. The bypass outfall could be shifted to a place where predators are unlikely to congregate.

- The area below the dam could be reconfigured to eliminate features of the large pool that make it ideal for holding large numbers of predators.

MOKELUMNE RIVER FISH HATCHERY

Chinook Salmon Return and Egg Take

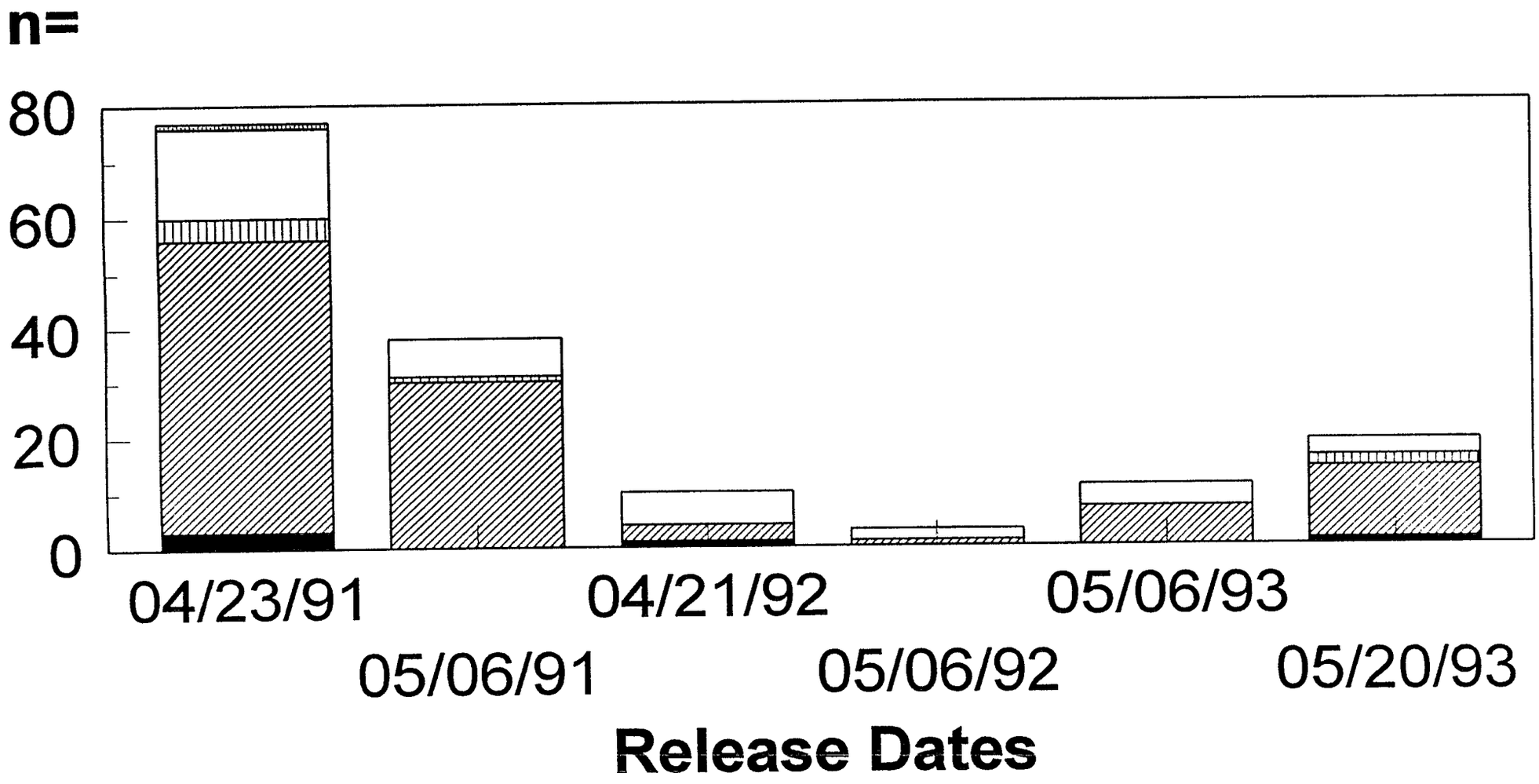
	1993	1994	1995	1996
Adult Females:	794	582	1,260	880
Adult Males:	748	584	1,118	948
Grilse:	622	752	945	2,055
Total Returns:	2,164	1,918	3,323	3,883
Egg Take:	2,951,595	2,626,000	4,886,641	3,806,588

Fish totals from draft DFG annual reports and weekly anadromous fish count reports.

96escp3.wk4

Delta Mortality Study

Adult Recoveries by System



Hatchery and river recoveries pooled

River recoveries not expanded to reflect effort

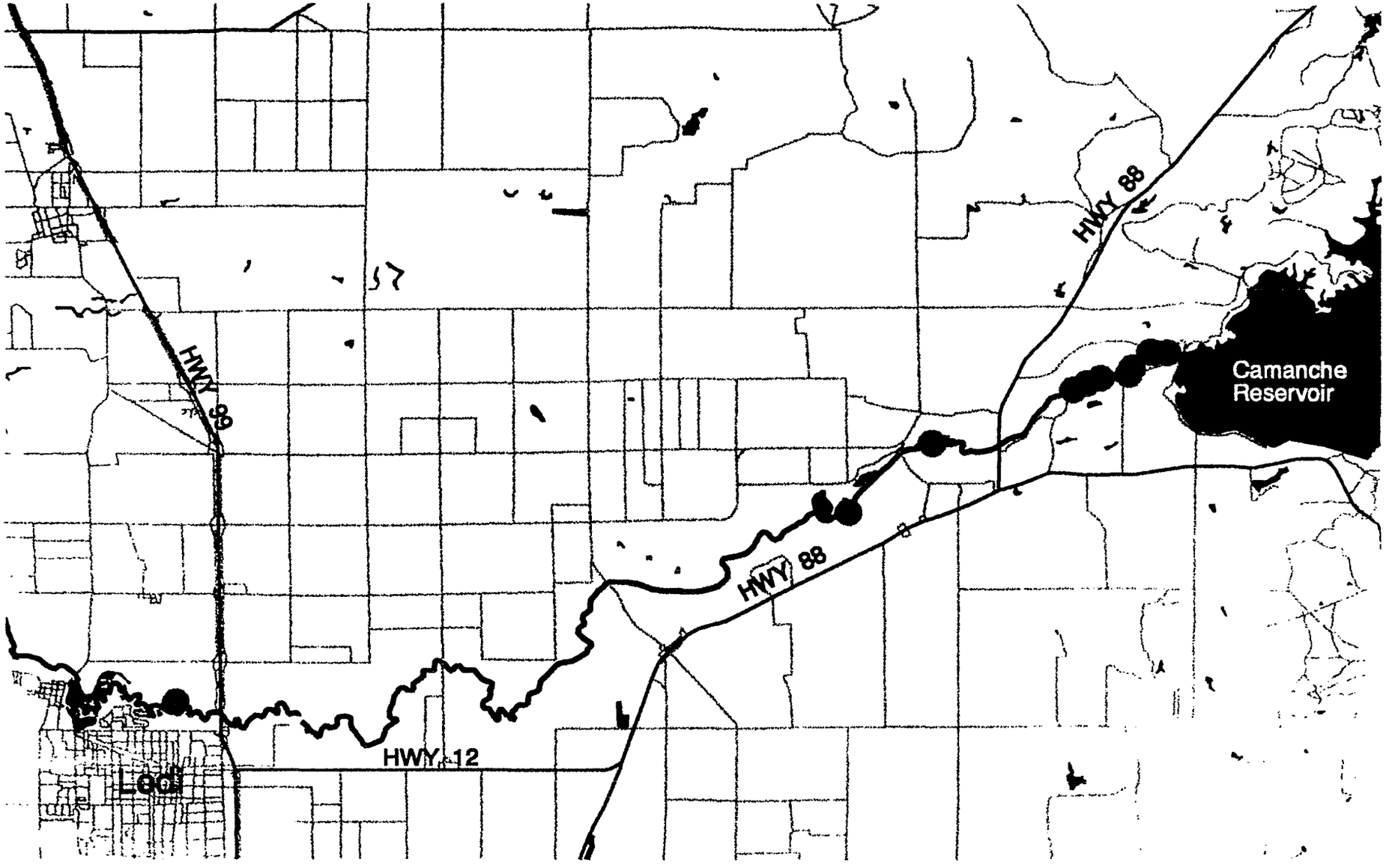
Recovery Data as of December 1994

EBMUD

CURRENT MANAGEMENT ACTIONS

- Voluntary implementation of the FERC POA flows
- Cooperative efforts to improve spawning habitat
- Cooperative efforts with Natural Resource Conservation Service for erosion control and streambank vegetation protection
- Woody debris management with the City of Lodi
- Shift in catchable trout stocking program
- Use of upper outlet for temperature control
- Warning signs to prevent anglers from wading on redds
- Mokelumne River ArcInfo GIS

Mokelumne River Enhancement Sites



- Completed Enhancement Sites
- Proposed NRCS Site
- Proposed City of Lodi Site

0.86 0 0.86 1.72 Miles

N
W E
S

D-026982

D—026982

APPENDIX D

Prospect Island Restoration Plan

D-026983

RECEIVED SEP 1 6 1996

Section 1135 Preliminary Restoration Plan

Prospect Island

RECEIVED
APR - 4 1997

Project

The Corps constructed projects being modified by the Prospect Island Project are the Sacramento River Flood Control Project and the Sacramento River Deep Water Ship Channel (ship channel). The Sacramento River Flood Control Project consists of approximately 1,000 miles of levees plus overflow weirs, pumping plants an bypass channels that protect communities and agricultural lands in the Sacramento Valley and Sacramento-San Joaquin Delta. Prospect Island is located entirely within the Yolo Bypass. The ship channel was completed in 1963. The existing ship channel was authorized in 1946 by Public Law 79-525. The principal features of the ship channel include the 30-foot-deep navigation channel extending from Suisun Bay to Sacramento, California, a harbor, and a shallow-draft barge canal that connects the harbor to the Sacramento River. The harbor includes a turning basin at Washington Lake. Vessels travel up the channel at about 9 to 10 knots. The Port of Sacramento (Port) is the local sponsor for the ship channel. Maintenance dredging of the ship channel was conducted in 1969, 1974, 1981, 1984, and 1994.

The project is located in the State Of California in the 4^{rth} Congressional District.

Authority

Section 1135 (b) of the Water Resources Development Act (WRDA) of 1986, as amended.

Location

Prospect Island is located in the northern portion of the Sacramento/San Joaquin River Delta. It is bordered on the west by the ship channel, to the east by Miner Slough, to the south by the confluence of Miner Slough and the Ship Channel and to the north by remnants of Little Holland tract. The entire island is about 1600 acres. The study area is about 1300 acres.

Description of the Proposed Modification

Existing Conditions

Prospect Island covers about 1600 acres and provides shallow water habitat for fishes only during major flooding caused by levee overtopping or breaching. At such times, the island would likely contain the same species as the Sacramento River and other flooded islands. Fish known to inhabit the vicinity are inland silverside, yellowfin goby, threadfin shad, hitch, Sacramento squawfish, prickly sculpin, Delta smelt, bigscale perch, fathead minnow, mosquitofish, Sacramento splittail, largemouth bass, crappie, white and channel catfish, bluegill, tule perch, Sacramento sucker, and other sculpins and minnows such as observed in Cache Slough. The US Fish and Wildlife Service (Service) sampled the ship channel in 1994 and found chinook salmon, striped bass, American shad, largemouth bass, white catfish, channel catfish, bluegill, carp, and Sacramento squawfish.

Anadromous fish species in the Sacramento River and deeper channels (greater than 12 feet) of the Delta include chinook salmon, steelhead, striped bass, American shad, white sturgeon, and Pacific lamprey.

Although Prospect Island has nine existing cover types: upland, non-tidal open water (ditches, drains, and canals), riparian forest, riparian scrub-shrub, non-tidal emergent marsh, shallow flood cover, shaded riverine aquatic cover, agriculture, and bare ground, most of the 1,300 acre study area is agricultural.

The ship channel and Miner Slough levees are riprapped. The large rock riprap of the ship channel supports no vegetation. However, a bench of up to 40 feet wide is present outside the levee toe on the northern two-thirds of the ship channel. Small stands of mature cottonwoods and willows grow on the benches. Smaller trees, primarily willows up to 15 feet high, and shrubs such as blackberry grow through the riprap along the outer slope of the Miner Slough levee. About two-thirds of the perimeter of the site is ringed with early successional and mature riparian or riparian shrub-scrub vegetation.

Ownership

1,228 acres of the study area are owned by the US Bureau of Reclamation (Reclamation). The remaining 70 acres of the study area are on the ship channel levee, which is owned in fee by the Port of Sacramento (Port), with the Corps owning an easement on the levees. The Port also owns about 310 acres to the south of the Island. Two private landowners own about 22 and 9 acres on properties that are attached to the east side of Prospect Island. The California

Department of Fish and Game owns 37 acres at the extreme southern tip of Prospect Island.

Environmental Problems

Prospect Island is contiguous with the ship channel. Construction and operation of Corps navigation projects, such as the ship channel, resulted in adverse impacts to fish and wildlife habitat. These impacts included the disposal of dredged material in wetlands and loss of riparian, upland, and emergent marsh vegetation. The most common habitat affected by this practice was probably farmed wetlands. Ship channel levees, such as the one located on Prospect Island also resulted in the displacement of natural vegetation.

Flood control projects, such as the Sacramento River Flood Control Project, also affected fish and wildlife habitat. Prospect Island is within the Yolo Bypass and is next to one of the Yolo Bypass levees, which is part of the Sacramento River Flood Control Project. Flood control activities usually require the removal of waterside and landside vegetation. Loss of waterside vegetation affects fisheries because freshwater tidal marsh and shaded riverine aquatic (SRA) habitats are removed. Loss of waterside vegetation also affects wildlife because riparian, shrub/scrub, and emergent marsh vegetation are removed. Landside vegetation removal affects wildlife because upland forest, scrub/shrub, and agricultural habitats are no longer available for wildlife use. Typically, vegetation is lost from bank protection activities for erosion control, or from levee improvement activities that require raising and widening existing levees.

Wetland, riparian and upland habitats are required habitats for almost all of the Delta fish and wildlife. Less than 4% of the delta's original wetland habitat remains. Riparian and upland habitats have also been dramatically reduced. Given the lack of critical habitats for delta fish and wildlife, the addition of these habitats is needed.

Without Project

Without the project, no action would be taken by the Federal Government to improve environmental values of Prospect Island. Without the project, Prospect Island would continue to be owned by Reclamation, and the land would continue to be farmed. Reclamation has no intention of restoring Prospect Island and would continue to lease it out for agriculture. Therefore, no habitat restoration features would be constructed, and the Corps would continue to expend an average of over $300,000 per year for maintenance of the ship channel levee at Prospect Island.

With Project

With the project, restoration would be implemented by modifying the existing navigation project. The plan would restore tidal wetland, riparian, SRA, upland, mudflat, and open water habitat at Prospect Island and relieve the Corps of over $200,000 per year in maintenance costs for the ship channel levee. The with-project condition is not likely to adversely affect the existing navigation project or flood protection level in the study area.

Purpose and Description

The purpose of this project modification is to provide spawning and rearing habitat for federally listed Delta smelt and proposed Sacramento splittail, rearing habitat for federally listed winter run chinook salmon and other anadromous fish, habitat for federally listed waterfowl and shorebirds and high quality riparian, shaded riverine aquatic, wetland mudflat, freshwater tidal marsh, upland and open water habitat for a wide variety of aquatic and terrestrial species in the delta. Currently the island is farmed and provides very little wildlife habitat.

These objectives would be reached by constructing interior islands within Prospect Island, stabilizing the existing levees by contouring the slopes to a 10:1 pitch, stabilizing the levees and islands with biotechnical plantings and hydroseeding the remainder of the site above the high tide line. The ship channel and Miner Slough levees would be breached in one place each, restoring full tidal action to the site. Islands would be located so that they act as a windbreak, preventing long fetch lengths from developing. Islands would be constructed so that upland, riparian, shaded riverine aquatic, riparian, freshwater tidal marsh, mudflat and open water habitats would grow at the appropriate tidal elevations. A channel would be excavated connecting the two breaches. The excavated material would be used to construct the islands and exterior levee embankments. The channel itself would provide a flow through, facilitating the movement of water through the site and discouraging predator fish from taking up residence in the site. Water in the site would be replaced daily by tidal action.

Consistency Statement

The proposed modification is consistent with the flood control, and navigation purposes of the exiting project. The modification will not adversely affect the operation of the ship channel or the Sacramento River Flood Control Project levees.

Views of the Sponsor

The sponsor, the California Department of Water Resources (DWR) fully supports the proposed modification for the construction of restoration facilities at Prospect Island. Restoration activities at Prospect Island will provide much needed spawning and rearing habitat for federally listed Delta smelt and Sacramento splittail, rearing habitat for federally listed winter run chinook salmon and other anadromous fish, habitat for federally listed waterfowl and shorebirds and to provide high quality riparian, shaded riverine aquatic, wetland mudflat, freshwater tidal marsh, upland and open water habitat for a wide variety of aquatic and terrestrial species in the delta. The modification is supported by the Planning Aid Report prepared by the Service for the Prospect Island Fish and Wildlife Habitat Restoration Reconnaissance Study.

Views of Federal, State, and Regional Agencies

Many governmental and nongovernmental agencies have been involved in the planning and implementation of a restoration project at Prospect Island. Reclamation has purchased the property. The Service and the Bureau of Land Management both expressed interest in managing Prospect Island. The National Marine Fisheries Service, two implementing teams of the North American Waterfowl Management Plan, the Central Valley Habitat Joint Venture and the San Francisco Joint Venture, and the Western Regional Office of the Audubon Society are supportive of Prospect Island. The Trust for Public Lands brokered the land acquisition. The California Department of Fish and Game is supportive of the project, as is Dr. Peter Moyle, professor and author of Inland Fishes of California and Robin Kulakow, Executive Director of the Yolo Basin Foundation. Furthermore, Prospect Island is a Coastal America project. Other agencies that have participated in the planning process include Department of Fish and Game, Solano Co. Water Agency, and Port of Sacramento.

Status of NEPA Documentation

An Environmental Assessment (EA) is to be prepared in conjunction with the Project Modification Report (PMR). It is expected that preparation of an Environmental Impact Statement will not be necessary.

Implementation Costs and Benefits

The cost of implementing Prospect Island Habitat Restoration Plan is $5 million. The cost of preparing the PMR, including NEPA documentation is $506,000. Annual operations and maintenance is estimated to be $90,000 per year.

There is little freshwater tidal marsh remaining in the Delta. Creating interior islands within Prospect Island and breaching the existing perimeter levees on Prospect Island will provide an increase in wetlands, including freshwater tidal marsh, in the Delta.

Outputs of this project are expected to include about 200 acres of mudflat, 250 acres of freshwater tidal marsh, 250 acres of SRA, riparian and upland habitat and about 600 acres of open water. These habitats would provide a great benefit to fish and wildlife in the delta, many of which rely exclusively on riparian and wetland habitat for their habitat requirements.

SRA provides reduced water temperatures, decreased erosion of bank material, increased supply of terrestrial insects to fish, increased instream cover to help fish feed and avoid predation. SRA requires natural banks or levees which also provide potential habitat for bank swallow, rough-winged swallow, kingfisher, muskrat, beaver, and river otter. Riparian cover provides habitat for a host of terrestrial species, including the Federally listed valley elderberry longhorn beetle which is known to occur in the study area. Riparian habitat also benefits the California tiger salamander and western spadefoot toad, two candidate 2 species for Federal listing.

Sacramento splittail, Delta smelt, and winter-run chinook salmon were previously very common in the Delta, but their numbers have declined and their range reduced. The creation of open water, mudflat, freshwater tidal marsh, riparian, SRA and upland habitats directly benefits the life requisites for these fish species. The shoal areas created by riparian, freshwater tidal marsh, and mudflat areas would provide important rearing grounds for Delta smelt. The Cache Slough mitigation area, a similar project located less than 1½ miles away, provides habitat for numerous smelt. The limiting factor of smelt populations is probably the lack of rearing areas. The restoration of Prospect Island would provide habitat for smelt spawning and rearing.

The requirements of splittail are similar to smelt. Splittail apparently spawn over flooded streambank vegetation or beds of aquatic plants. Their food consists of bottom invertebrates, such as amphipods, aquatic insect larvae, clams, and

earthworms. Tule marsh, mudflat, and riparian habitats created by this proposal would provide spawning areas and invertebrates for feeding.

All salmon would greatly benefit from restored riparian habitat. Prospect Island is expected to provide about 45,000 lineal feet of SRA. SRA occurs along streams or rivers where the bank is composed of natural materials and supports riparian vegetation which overhangs or protrudes into the water. SRA is a habitat requirement for rearing salmon, including the federally listed winter run chinook salmon. The SRA created at Prospect Island would benefit in the form of rearing habitat for winter-run chinook salmon during wet years.

The proposed channel through the center of the site connecting one breach to another directs a constant flow of water through the site and provides deeper water, which salmon prefer. The channel design would discourage predator fishes and also help to restore full tidal action to the study area

In addition to the direct benefits that Prospect Island would provide for fish and wildlife, a restoration project would provide a variety of incidental benefits, such as the following:

Although not designed for such activities, the proposed project would provide opportunities for bird watching, relaxing, and possibly canoeing or kayaking. The conversion of farmland to wetland would expand the habitat of many important recreational and commercial fish species and provide opportunities for fishing.

A healthy wetland system would have a positive impact on water quality. Wetlands improve water quality by retaining pollutants, delaying their movement as water circulates through the system. This allows pollutants to be used by plant processes and other biochemical processes and be converted to less harmful substances. Pollutant detention further allows sediments to settle. Pollutants include toxic chemicals, disease-causing micro-organisms, pesticides, and fertilizers.

Furthermore, the project would result in a reduction of agricultural drainage water. The study area is currently being farmed under conventional agricultural practices using chemical pesticides and fertilizers. Removing this land from agricultural production would eliminate the use of these chemicals on the study site.

Some additional studies will be conducted. Because of Prospect Island's proximity to the ship channel, there is the possibility that ships passing through the

ship channel may cause some drawdown and surges through Prospect Island, resulting in scour potential. Scour potential will be investigated during the preparation of the PMR so that erosion will not occur. Furthermore, the effect of inundation of Prospect Island will be studied to ensure that no seepage occurs on adjacent island as a result of inundation.

Operations and Maintenance

The non-Federal sponsor, DWR, would assume all O&M responsibilities for the Prospect Island project. The Corps would abandon maintenance activities on the ship channel levee adjacent to the study area; since the island would be flooded, it would not be necessary to maintain the ship channel levee to keep the island from flooding. Abandoning maintenance would relieve the Corps of the over $200,000 annual average maintenance cost of maintaining that levee.

Environmental Costs

Flooding reclaimed Delta islands could incrementally reduce the amount of freshwater outflow release and increase the amount of saltwater intrusion. The modest degree of subsidence (much of Prospect Island is above sea level) and small area of Prospect Island would minimize or eliminate this potential impact for the proposed restoration.

The valuable habitat complex that would be restored by implementing this project would be created at the expense of agricultural land.

Implementation Schedule

Task	Start Date	Completion	Time	FY
Prepare PMR and Draft PCA	~~Nov 1995~~ July 1996	~~August 1996~~ July 1997	~~10~~ 12 months	96
Approval of PMR	~~Sept 1996~~ Aug 1997	~~Oct 1996~~ Sept 1997	2 months	96
Prepare Plans & Specs	~~Nov 1996~~ Oct 97	~~April 1997~~ March 98	6 months	97
Execute PCA	~~May 1997~~ April	~~June 1997~~ May	2 months	97
Advertise and Award Contract	July 1997 June	~~Aug 1997~~ July	2 months	97
Construct Project	~~Sept 1997~~ July	Sept 1998	12 months	97&98

Supplemental Information

Construction 1 yr
July 98

This project was considered in the April 1995 Reconnaissance study of fish and wildlife habitat restoration alternatives for Prospect Island. This restoration project is being pursued under Section 1135 of the 1986 WRDA, as amended to expedite construction, realize benefits as soon as possible, and take advantage of existing funding sources for the non-federal sponsor.

Financial Data

Project Modification Costs (in thousands)							
Program Element	Total	Non-Federal	Federal	Funding Requirements			
				FY95	FY96	FY97	FY98
Report	506	0	506	8	492	0	0
Plans and Specifications	437	0	437	0		400	0
Project Cost	3,937	1,220	2,717	0	0	3,380	600
Total	4,880	1,220	3,660	8	492	3,780	600

Non-Federal Requirements:

LERRD	$	372,800
Cash	$	847,200
Annual Operations and Maintenance	$	90,000

Appendices A and B present more detailed cost analyses.

Federal Allocations to Date

The restoration plan for Prospect Island was identified in the Prospect Island Fish and Wildlife Restoration Reconnaissance Investigation. Section 1135 study Federal allocations to date are as follows:

Preliminary Restoration Plan	$	5,000
Project Modification Report	$	0
Plans and Specifications	$	0
Construction	$	0

References

U.S. Army Corps of Engineers, 1995
Reconnaissance Report -- Prospect Island Fish and Wildlife Habitat Restoration Study, California. Sacramento District, California.

U.S. Army Corps of Engineers, 1995
Draft Circular E.C. 1105-2-206, Project Modifications for Improvement of the Environment. Washington, D.C.

Appendix A

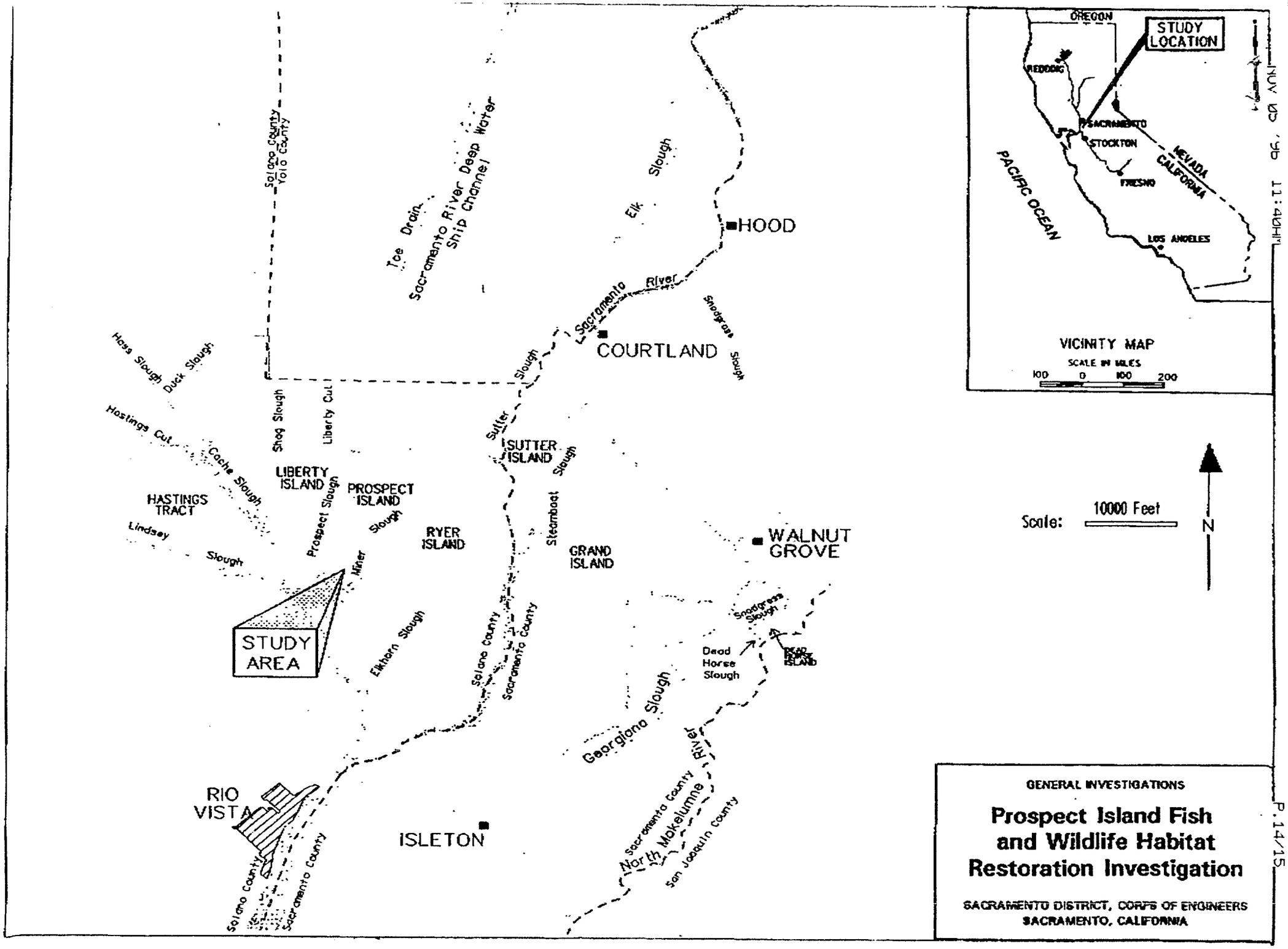
Cost Estimate for Prospect Island Project Modification Report

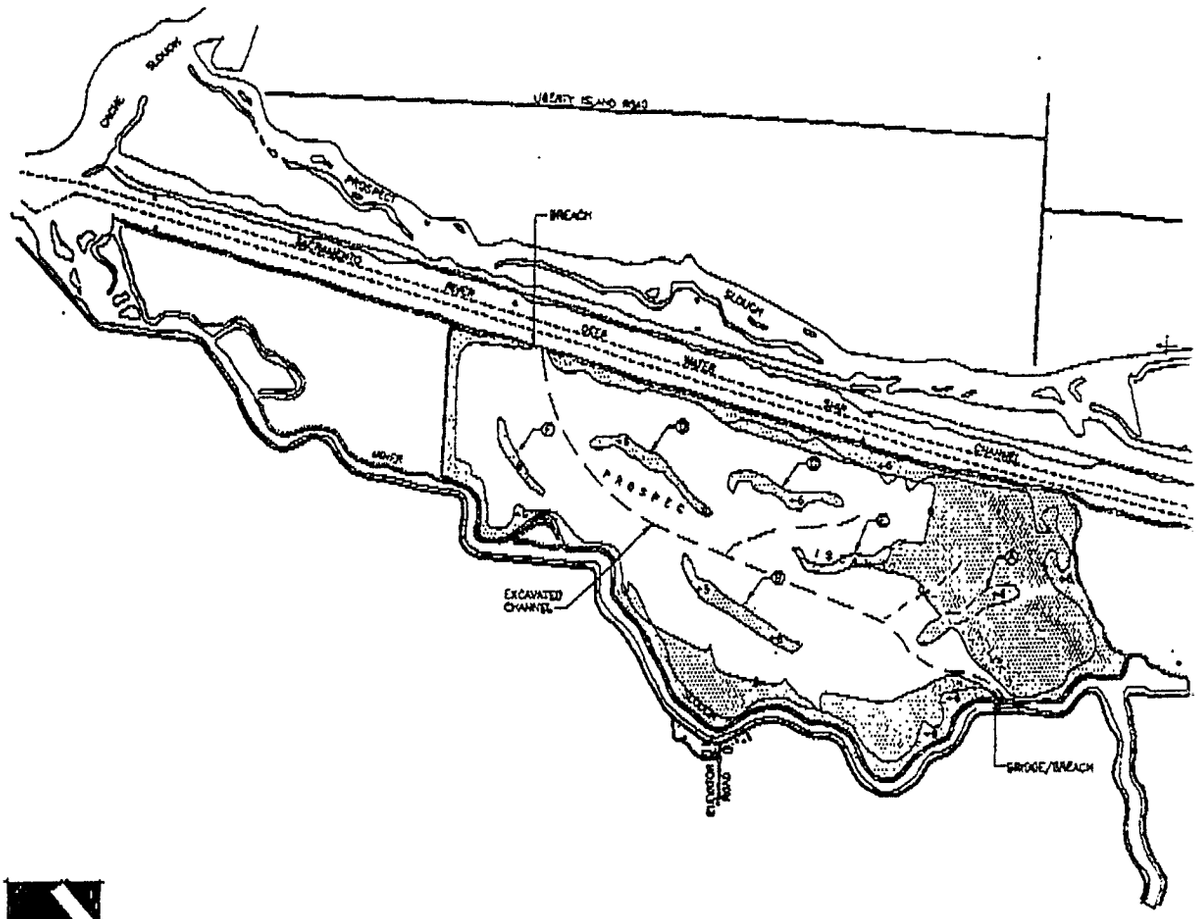
Work Elements		Work Element Subtotal
San Joaquin Basin Branch		
Study Management	40,000	
Plan Formulation	40,000	
Report Preparation and Review	30,000	
PCA Development	10,000	
		120,000
Public Involvement		
Public meetings, mailing lists, preparation, Editing	10,000	
		10,000
Environmental Planning Section		
Environmental Analysis, Coordination, EA/IS, Endangered Species Studies	76,000	
FWS CAR	32,000	
Cultural Resources Assessment	9,5000 95,000	
		117,500
Real Estate Division		
Revise Gross Appraisal	3,200	
Real Estate Supplement	9,000	
Real Estate Map	1,700	
Miscellaneous	11,000	
		24,900
Engineering Division		
Surveys and Mapping	32,400	
Hydrology and Hydraulics, develop 2D hydrodynamic model, conduct RMA-2 modelling studies, modify existing TTN model to describe current design.	36,000	
Engineering and Design	58,000	
Soils	38,000	
HTRW Studies	60,000	
Cost Estimates	9,800	
		234,200
Grand Total		506,600

Appendix B -- Total Project Cost

ITEM	Quantity	Unit	Other	Total Cost	Unit Co
Fish and Wildlife Facilities					
Remove power poles and wiring	10	ea		9304.8	930.4
Pumps, misc structure & pipe remove	1	ea		11000	
Clearing and grubbing	200	acre		333564	1667.8
Signs	4	ea		1231	307.75
Excavation, breaching	8000	cy		36800	4.6
Gravel, levee	10100	tn		0	22.33
Steel bridge, levee	1	ea		281000	281000
Biotechnical slope protection levees	20400	lf		351900	17.25
Riparian/upland vegetation	9	acre		0	13800
Riparian/upland seedling cover levees	13.6	acre		46920	3450
Plant waterside for levee	4.4	acre		0	13800
Embankment levee	111000	cy		382950	3.45
Embankment island	520500	cy		1009770	1.94
Biotechnical slope protection islands	30880	lf		532680	17.25
Riparian/upland vegetation islands	10	acre		0	13800
Riparian/upland seedling cover	20.4	acre		70380	3450
Mob and demob – mobilization	1	ea		148000	148000
Cultural Resource Protection				55000	
Real Estate Costs – (25% facility contingency)					
Severance				287649	
Administrative Cost				60000	
Flood Easement				138	
Contingency				35	
Relocation				25000	
Total Fish and Wildlife Facilities				3643321	
Project Modification Report			506600		
E & D 12% of Construction			437198.6		
S & I 8% of Construction Cost			291465.7		
Total Cost of Project				4,878,586	

D-026995





0 1000 2000 4000
SCALE IN FEET

PROSPECT ISLAND
FISH & WILDLIFE HABITAT RESTORATION

CORPS OF ENGINEERS, SACRAMENTO DISTRICT

D-026997

D-026997